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VOLUME 64 AUGUST 1950 NUMBER 2

COPYRIGHT, 1950, BY THE AMERICAN MEDICAL ASSOCIATION

DIRECT REORIENTATION OF BEHAVIOR PATTERNS IN DEEP NARCOSIS (NARCOPLEXIS *)

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NEW YORK

STATEMENT OF PROBLEM

IT IS NOT known what happens in the cortex when the reaction patterns of a growing child are laid down and then become established as enduring foundations of behavior. However, it is highly probable that these events are not the result of anatomic changes in the cortex; it is hard to imagine dendrites or axons changing position so as to set up new connections. The establishment of patterns is more likely to depend on a physiologic process, conceivably facilitation. Hence there is a chance that the neural process of pattern fixing may be reversible.

Indeed, it is known that when psychotherapy is successful the patterns do change. Old ones disappear, to be replaced by new ones, or old ones may so change as to look like new ones.

The present study began as an attempt to answer the following questions: If the neural arrangements underlying reaction patterns are reversible, could an adult's patterns be erased by a physiologic process which would attack these neural arrangements? In other words, could an adult be made, theoretically, patternless—could he be returned to a state of neurologic and psychologic infancy for a short period? If he could, then could the formation of new patterns be promptly induced during this period, when old patterns were absent? If new patterns were set up, would they be enduring? If affirmative answers to these questions could be given, or even approached, could the procedure be employed psychotherapeutically? If so, one would have a means of altering behavior by working with some of its fundamental neural foundations, and the most basic aspect of therapy would be on a physiologic level. Ultimately, this might lead to a more detailed understanding of the physiology of behavior.

This study was aided by the Fund for Research, Inc.

* This term is derived from the Greek verb πλήττω, meaning "to strike," particularly suddenly. For this derivation we wish to thank Mr. J. M. Conant, of the Department of Greek and Latin, Columbia University.

We assumed that the neurologic and psychologic state of infancy we sought might exist in any state of clinical unconsciousness. We chose intravenous administration of amobarbital sodium (amytal® sodium; sodium isoamylethylbarbiturate) as the means of inducing this state, because of the known accessibility and responsiveness of patients while under the effects of this drug. However, the doses we employed were much larger than those ordinarily used. Procedures were devised in an attempt to answer the questions proposed. Certain quite specific and enduring changes in reaction patterns, many of them basic, did result from the employment of these procedures.

The questions do not all have affirmative answers, however. Patients do not become patternless. The drug, in proper doses, does seem to render functionless the neural machinery for some patterns, but it leaves the machinery for others apparently intact. We believe that the patterns which disappear are mainly the most complex ones—those of complex evaluation and those of highly culturalized behavior; remaining rather vividly exposed seem to be the more underlying, less highly culturalized, fundamental patterns of behavior and reaction. Under such conditions of exposure, these underlying patterns often seem directly susceptible to attack.

Neurologically speaking, the networks dealing with these more fundamental patterns seem to be left exposed by obliteration of the function of the rest of the cortex. Properly designed stimuli may activate these networks more specifically and directly than could be done if the whole cortex were operating in a normal manner.

Once these networks are activated in the manner described, the behavior patterns which represent their function may undergo changes promptly.

PROCEDURE

Thirty-nine patients with psychoneuroses or psychoses or borderline states were treated.[2] Thirty, with at least one year of follow-up observation, are reported on here; illustrative material is drawn from all the patients, however.

Psychologic Tests.—The patient receives psychologic tests, usually the Rorschach, Szondi and Bellevue-Wechsler tests.[3]

1. Footnote deleted.

2. Patients were referred by the following physicians (all from New York city unless otherwise stated): Drs. F. Dennette Adams, Boston; Samuel Averbuck; Anny Baumann; Robert Buchanan, Billings, Mont.; Samuel Freedman; David Feinberg, Easton, Pa.; Nathan Feinberg; Maurice Goldberg; Benjamin H. Gottesfeld, Hartford, Conn.; Robert Groh, Washington, D. C.; Lawrence Jacobius; David Kurschner; I. W. Kramer, Great Neck, N. Y.; Howard E. Lindeman; Henry Marks; Eli Moschcowitz; Abraham Ornstein, Philadelphia; Tracy Putnam, Beverly Hills, Calif.; Norman Reitman, New Brunswick, N. J.; Frank P. Sainburg; Byard Williams.

3. The tests were administered by Drs. Molly Harrower, Joseph Levi, Ruth Munroe and Simon Tulchin.

History.—A fairly thorough acquaintance with the patient and the dynamics of his personality is obtained in interviews, by eliciting a thorough life history and sometimes by studying his dreams. The history is not only episodic but also contains whatever information can be gained about the personality structures of members of the immediate family. As many people as possible who knew the patient during infancy and childhood are interviewed. From all this information, a reasonably good picture may be gained of the patient's most important reaction patterns and of the experiences and orientations which produced them.

Treatment Procedure.—1. Report: The patient starts each session by giving a half-hour report of experiences both external and internal. He brings in his dreams, written out.

2. Administration of the Drug: Amobarbital sodium solution is given by vein at the rate of about 1 cc. (0.975 Gm.) per minute. Administration is stopped only when the patient is in clinical coma; that is, he appears to be asleep and does not respond to external stimulation. The corneal reflexes are usually abolished, but the pupillary and tendon reflexes are preserved. The doses ranged from 6 to 17½ grains (0.39 to 1.14 Gm.); usually they remain constant for each patient.

3. Scripts: Prepared scripts are read to the patient. These are designed to approximate important situations in infancy and childhood, and the situation rather than the specific event is stressed. The situations are managed in the scripts so as to eventuate more happily than the patient felt they actually did. We emphasize one of several early patterns which we think would be a more profitable "main channel" than that which has been dominant. For example, a parent who either was, or was thought to be, rejecting is described according to whatever loving attributes we believe him to possess.

The patient's own symbolic language, as expressed in dreams and while he is waking from the drug, is often employed in scripts.

Script reading continues for one hour unless the patient awakens sooner. The scripts average 1½ pages in length; usually 2 or 3 are read in a session. Hence, each is repeated usually five times per session. The first reading is recorded on wire, which is then played back for the other readings.

Scripts are usually read by the staff in the roles of members of the family. Occasionally reading is done by actual family members, especially by parents; evidence indicates an especially heavy impact under these conditions. Reading scripts to one's sleeping child or sibling is a difficult, dramatically educative experience, which may favorably influence the family's attitude toward the patient. Scripts read by actual members of the family are so designed as to minimize trauma to the reader, and also to be of educative value to him.

The material for the first scripts is derived from our initial knowledge of the patient. As the process advances, we use additional knowledge and additional points, gained from several sources. Some of these are apparent in the excerpts from scripts to follow. These sources are sometimes the patient's reactions during the reading period, the material he produces while waking, his interval dreams—especially those of the nights of treatment when he is still under the effect of the drug to some degree—and his interval emotional reactions, particularly those immediately following a session.

In designing scripts, we have tried to avoid the indiscriminate application of preconceptions to patients and to be guided only by specific evidence supplied by the patient. Every attempt has been made to eliminate speculative theory except on certain specific occasions. The working principles which follow have been regularly employed; we believe some of them to have the stature of facts, others to be exceedingly well grounded theories and all probably to have high and

notable biologic and cultural importance. 1. Reaction patterns begin to be formed very early in life. After some use, they tend to become permanent. 2. The receipt of love from parents in infancy and young childhood is indispensable to adequate adjustment later, in our culture. A strong feeling that one is rejected by a parent may lead to important emotional difficulties. 3. The acceptance of the child's sex by the parents is of great importance.

The earliest scripts are, therefore, usually devoted to portraying an eager, loving attitude of the parents toward the patient's birth, with some emphasis on acceptance of the baby as a boy or girl. Scripts in which the patient is nursed lovingly ordinarily follow; when indicated, weaning is explained as a necessary, but nonrejecting, event.

The following factors are regarded as more variable in their importance and are worked with if evidence indicates a need for it: (1) a triangular (oedipal) situation, involving child and parents, with implicit jealousies, hostilities and longings; (2) hostile feelings of various degrees (nonoedipal) toward various members of the family; (3) competition and rivalry with siblings; (4) various guilt feelings, guilt concerning masturbation and hostile feelings toward members of the family being frequently important; (5) so much dependence on a parent that the development of an independent self is impeded. This dependence may hinge on hate as well as love.

Scripts relating to oedipal rivalries sometimes consist of the retirement of a parent so the patient may have the other parent all to himself, or of a childhood marriage to one parent with the support of the other. If we see evidence of a sexual conflict with reference to the oedipus situation, we use it in scripts; we have not hesitated to grant coital relations with a parent or sibling in a script if the patient's needs, plainly expressed in dreams or otherwise, call for it. This is stated as the childhood wish it supposedly was, with emphasis on the attitude that once the wish is granted as of childhood the patient will be free to drop it and as he matures develop an interest in people of the opposite sex belonging to his own generation. We have frequently managed intense hostility by having the patient actually kill the hated person in a script. One of us (J. H.) developed the idea that death wishes ordinarily are not all-inclusive for the hated person; a child does not usually want his entire father dead, but wants only that part of him to die which he hates; he would preserve the other aspects of his father. Evidence appears to support the truth of this assumption. Commonly, therefore, we introduce a surviving good parent or sibling.

The remaining scripts are composed to meet the patient's needs, by his own evidence.

Excerpts from some typical scripts are:

Nursing Script: "Jimmy . . . my darling . . . let me hold you . . . close . . . warm. . . like this. . . . You're smiling! . . . You know me! . . . One day old, and you smile for mother already. . . . Yes, Jimmy . . . I know . . . Of course you're hungry. . . . You want your milk . . . you want my breast . . . Just as much as I want to give it to you. . . . Here, baby . . . my little man. . . . Here it is . . . my breast . . . nice and warm and full of sweet, good milk for you. . . . Take it, darling. . . . It's all yours . . . Daddy was just here, and he wants you to have my breast too. . . . Hold on and suck, darling. . . . I'm so glad I have milk in my breast for you . . . so you can grow up strong and healthy . . . a man."

Dan Kills Mother and Lets Good, Loving Mother Live: "Dan! . . . Dad's certainly proud of the way you played your part on the team. . . . I guess that'll show mother that she can't interfere any more when you want to get in

the broad jump competition next year at camp. . . . I guess that'll show her that she has a real man on her hands now. . . . And now you're going to kill mother because she's so cruel to you? . . . That's a good idea, Dan. . . . She is cruel. . . . Yes . . . She's cruel to me too. . . . You know she never lets me make love to her, Dan. . . . But she's much crueler to you than she is to me. . . . Why, she made you put your two little white mice you loved so much down in the cellar, and what happened? They ran away! . . . And then when I bought you that little puppy . . . just because his tail had been clipped and he was forever getting a little spot of blood on the rug, she made us get rid of it . . . that was mean. . . . She's selfish, and you must kill her. . . . I understand. . . . Dad knows. . . . She tried to run you, Dan. . . . She doesn't want you to be a boy and fight like other boys. . . she wants you to be a sissy . . . And I know you want to be all boy. . . . So go ahead and kill your cruel scheming mother, Dan. . . . That's right! . . . Hit her. . . . Break her tooth [4] and kill her, Dan! . . . Hit her, Dan. . . . There, you've broken her tooth. . . . See the ugly effect. . . . She's holding the piece of front tooth in her hand. . . . Hit her again! . . . Knock her down and hit until she's dead! . . . You did it, Dan. . . . Mother's dead now. . . . You've killed her, and now you can have a sweet, loving mother. . . . The mother you let live will certainly let you have a dog any time you want one. . . . And she wants you to play your part on the team. . . . You can be a boy now, Dan. . . . Your kind, warm mother will let you. . . . She loves you as a boy. . . . See, she's smiling at you and loving you now. . . . Your cruel mother is dead. . . . You killed her. . . . And your new mother's glad!"

Dad Explains Himself and Assumes Masculine Role While Mother Urges Hank to Identify with Him as a Vigorous Male: "Hank! . . . This is dad. . . your good dad. . . . I'm a man . . . just as you're going to be when you grow up. . . . Come, son. . . . I'll let you gas the Cardinal [a station wagon]. . . . Now, while you're still a little boy you need my help in keeping the Cardinal in good shape . . . but when you grow up you'll be able to gas it all by yourself . . . and drive it in a very relaxed, easy manner . . . because you're growing up to be a man . . . like me. . . . You notice, Hank . . . that I don't let mother push me around any more. . . . No more than you do. . . . Mother's a woman now . . . really feminine and soft, and I'm the boss around this house. . . . We're men, you and I. . . . I'm Thomas Jefferson. . . . the kind of dad you always wanted . . . a mountain ram . . . with horns . . . masculine . . . sure I am. . . . You and me . . . we work together. . . . We use can openers . . . of course we do . . . because we can see and know what can openers are . . . We do men's work together. . . . Mother's dressed in a magnificent costume . . . beautiful . . . feminine . . . and she's soft and loving. . . . She wants me to be a man too . . . just like you. . . . Didn't I put my foot down about you being just a maid in the house? . . . I just up and forbade it, didn't I? . . . Sure I did. . . . We have men's work to do . . . with our Paramecia culture. . . . Let's work together on it . . . now, Hank. . . . Dad and son together . . . two men."

4. Reactions During Script Reading: During the reading period patients move in various ways, change their respiratory rates grossly, and so on. Each such event is recorded as a reaction to what is being read; this cannot be entirely correct, for people are apt to move during any hour of sleep. However, we have good reason to think that many of these events are true reactions to script material. Since there is no way to tell which movements, and other

4. Example of the employment of the patient's own dream language in a script.

responses, are or are not genuine reactions, we must either record them all as reactions or abandon the chance to study the real ones; the former course has seemed the more fruitful, and allowance is made for the error. The script line to which the supposed reaction occurs is underlined so as to note it for future study.

We have not yet been able to obtain continuous recordings of pulse, respiration, blood pressure, skin temperature and other factors, which it should be desirable to observe. These might add more certainty to the identification of true reactions.

5. Wake-Up Period: The patient is usually still asleep at the end of an hour, and an effort is made to wake him by speech, by stirring his shoulder or by lifting him. Whether this is required or the patient has awakened spontaneously, one-half hour of actual intercommunication is devoted to the "wake-up" period; the patient, who repeatedly tends to go back to sleep, is continually reawakened and asked to state his thoughts or dreams. Obtaining one-half hour of communication may involve a period as long as three hours, depending on the depth of sleep, the occasional rebellion of the patient or states of rage sometimes precipitated by the scripts. When sufficiently wakeful, the patient leaves, under escort.

6. Transcription and Interpretation of Material: Mechanical or electrical transcriptions (soundscriber® and Webster-Chicago wire recorder) are made of all that happens during sessions. For the sake of anonymity, initials instead of last names are typed. The material is interpreted intensively and integrated, copious notes being written in the wide margin. Particular attention is paid to any apparent influence of the scripts on the content of the wake-up period, on dreams and on emotional reactions during the wake-up period and directly following a session. The patient's report and the interval dreams are studied prior to the next session, so that important points from them can be employed immediately.

We are apparently correct to a high degree in the recognition and interpretation of trends and their changes, but our score may not be much better than that dictated by chance in specific symbol interpretation. The early portions of the wake-up material frequently seem to represent unedited reports of dreams as they are being dreamed; the language is that of the dream itself and is often harder to interpret than that of ordinary dream reports. Ordinarily, descriptions of dreams given after the event have a conventional kind of coherence; they have been filtered through the waking cortical organization and are presented in conventional language.

The most important parts of the material are transferred to a chart (fig. 1). Here, terminations of old trends and beginnings of new ones can be marked off, and other salient points may be noted in their relation to the background. The various psychologic movements of the patient can often be visualized in relation to the scripts, and what is believed to be cause and effect can frequently be discerned specifically. Moments, or one to three day periods, in which occur changes that are often lasting can frequently be recognized. Comprehensive reviews can be made, and relationships between various developments can be seen. Any errors in our own viewpoints can be detected in time to correct them, and specific future plans can be made. One can see whether changes are held or tend to disintegrate between sessions. One can observe whether the patient moves mainly toward one of several psychologic polarities, or whether he swings continually from one to another; in the latter event (patient 22, in particular) steps can be taken to help him adhere to one.

We believe that the specificity and clarity with which these, and other, processes can be followed on the chart lend accuracy to the whole procedure. The contents of the chart are later put into the form of a bargraph, which represents beginnings

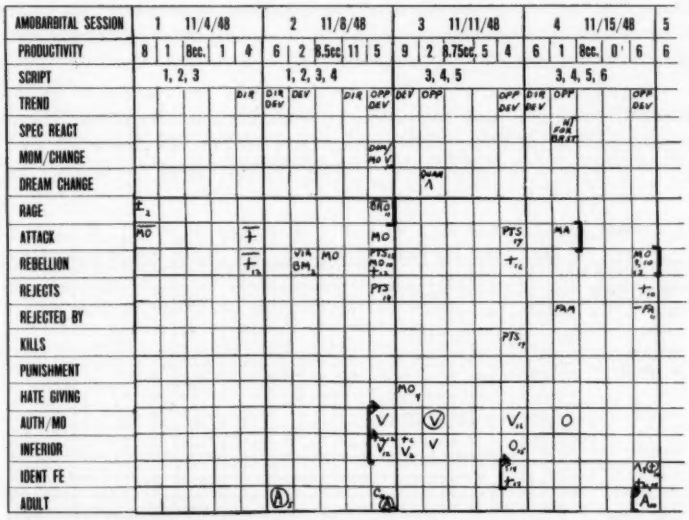

Fig. 1 (patient 23).—Sample of a part of a chart to illustrate its composition. Productivity line: First box, number of pages of report; second box, number of dreams; third box, number of cubic centimeters of amobarbital injected; fourth box, number of reactions to script reading; fifth box, number of pages in wake-up. Five boxes across make up one session. Heavy brackets facing left indicate ends of old trends; heavy brackets facing right, beginnings of new trends. Arrows on the latter mean that the new trends lasted until at least the end of the narcosis series. Explanation of terms used in figures 1, 2 and 3 follows: *SCRIPT*, title and/or number of script or scripts read; *TREND, dir* is a direct trend reaction to script material; *dev*, a developmental trend reaction to script material; *opp*, an opposite reaction to script material; *SPEC REACT*, specific reaction to script material; /, of; *MOM/CHANGE*, specific moment or period of change; *DREAM CHANGE*, change in dream content; *AUTH/MO*, mother's authority; *INFERIOR*, inferiority; *IDENT FE*, female identification; *ADULT*, identification of self as adult or child; *MA AS MA WANTS*, wish that males be clearly established and identified as masculine; *LOVE GVNG*, love giving; *CO-FE WANTS*, coitus wanted with female; *IDENT GENL*, ability to make identification with others in general; *IDENT MA*, male identification; *LOVE RCVNG*, receives love; *PUNISH FEARS*, fears punishment; *HATE GVNG*, gives hate; *CO WITH MA WANTS*, wants coitus with male; *MALE AS MALE O*, confusion in sex identification, in which masculinity is not clearly identified and identified as such; *DOM BY FE*, domination by females; *AUTH/MO* with inverted caret, authority of mother decreased; *INFERIOR*, with inverted caret, inferiority decreased; *IDENT FE*, female identification; *DEF/SELF*, ability to define the self; *FREE TO FUNCT*, freedom to function; *FE AS FE*, femininity clearly identified and defined as such; *POTEN HETER*, heterosexual potency; *LIBIDO HETER*, heterosexual libido; *MA RELATIONS WANTS*, wants relations with males; *MA IS MA*, masculinity clearly defined and identified as such; *DOM*, domination; inverted caret, decreased; caret, increased; symbol with wavy line above, present, but repressed; *pts*, parents; *bro*, brother; *fam*, family; *c*, child; *ma*, male; a circle surrounding a symbol means that the patient did not have, but wanted, what is indicated by the symbol.

and ends of trends, relations of changes to each other and to scripts, and other factors. The usefulness and degree of true substance in chart and bargraph may be appreciated by comparing the bargraphs in a successful and an unsuccessful case (figs. 2 and 3).

Although charts and graphs illustrate true shifts and changes in the main, consistent allowance is made for an error inherent in them; they cannot be mathematically correct, and they probably appear more definite than they really are. A trend may seem to disappear when we have perhaps missed the evidence for it

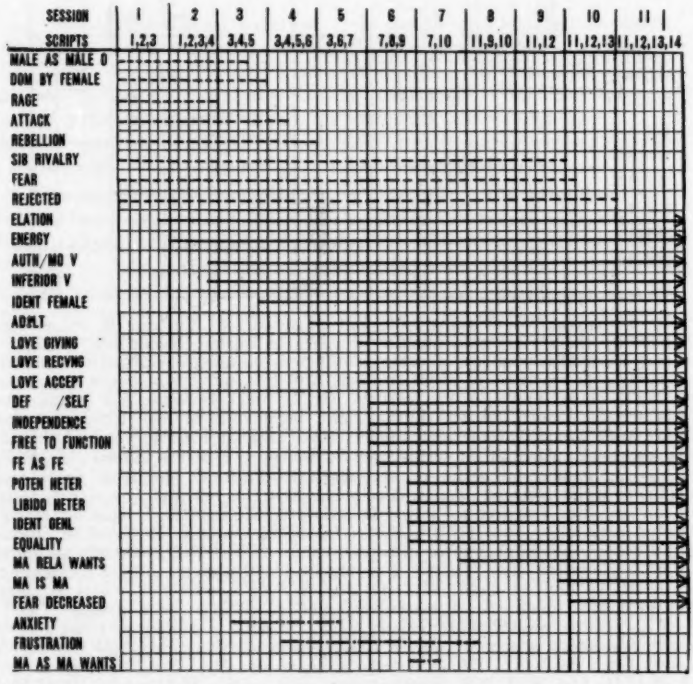

Fig. 2.—Bargraph for a successfully treated patient. The line of dashes indicates trends which ended; solid lines, trends which began; line of dashes and dots, interim phenomena. It is to be noted that many trends definitely end and that others begin and continue. They are still present at the time of writing, more than one year later.

or inadvertently classified it in a new way, such as calling it "rage," whereas we had formerly called it "hate." Also, the chart and bargraph necessarily iron out subtleties and include several factors under one heading; for instance, "love" is used in the chart to include respect, admiration, affection and other feelings. This is unavoidable if the chart is to be kept small enough to be useful. If one keeps such chances of error in mind, the charts and graphs are useful and relatively correct.

7. Termination of Narcosis Portion of Treatment: The sessions are terminated when a sufficient degree of change appears to have occurred in a sufficient number of underlying patterns that we think the remaining work can be efficiently accomplished with the patient awake. The average number of narcosis sessions has been sixteen.

8. Withholding of Conscious Insight During Narcosis: No conscious insight is given, and no interpretations are made to the patient during the narcosis phase. He knows only the general technic and its purposes. Yet patients occasionally gain conscious insight as the process goes along, sometimes to a high degree.

9. Repetition of Psychologic Tests: Immediately after completion of the narcosis sessions, psychologic testing is repeated.

10. Conscious Insight: The patient is then given the entire mass of his annotated material, including the history[5] and scripts, for study. He is guided

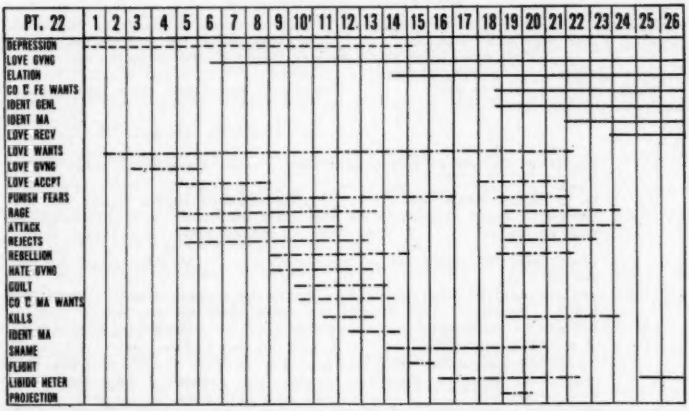

Fig. 3.—Bargraph for an unsuccessfully treated patient. Only one trend ends and only a few begin. Some persisted until the end of narcosis, but not much longer. Interim phenomena predominate, signifying that most trends start and stop and do not become lasting.

frequently and carefully as he reads the material. He notes his reactions to reading it and adds points brought to mind by it. He may differ or agree with interpretations he reads; sometimes he is reminded of additional information which changes an interpretation or has associations which may be constructive in their effects. Several weeks of intensive work are usually required for this stage of treatment.

11. Conscious, Constructive Effort: The last stage of treatment consists of follow-up work, with sessions usually once a week. The object is to help the patient employ the changes already achieved and to use his conscious insight (1) in completing necessary changes in reaction patterns, (2) in attacking whatever unsolved psychologic problems remain, (3) in working on subsidiary problems which have been uncovered and (4) in attacking real life problems.

5. Sections of the history given by members of the family are not included if they contain private confidences.

Much of this follow-up work is carried out in groups of patients after amobarbital treatment. To increase and facilitate learning, patients sometimes read the material of others in the group, by consent.

EVIDENCE THAT SCRIPT MATERIAL REACHES THE PATIENT

That the script material reaches the patient is indicated in several ways.

1. Not infrequently patients react again and again to the same line or to adjacent lines, of scripts. They may do this in various readings in the same session or in two or three different sessions in which the same script is read.

2. Highly specific reactions, especially verbal, to what is read occur occasionally during the actual reading period. For example, patient 11 awoke on the line,

Repeated Reactions to the Same or to Adjacent Lines in Scrift

MARRIAGE TO MOTHER

"GRFA: . . . So I'm certainly glad I was nice to Burton in his dream and drank oozo and milk with him. . . . Because that's the way I really feel. . . . And when I die, that's the way Burton should remember me . . . white . . . but as a pal.

MO: I knew you'd be glad. . . And when I told Joseph about Burt's dream, (6/2)

(6/3 - - - - - - - - - - - - - - - - - -)

(7/1 . — . — . — . — . — . — . — . — . —)

(7/2 . . . . . .)

you know, he was actually disappointed . . . He said he would like to

(- - - - - - - - - - - -)

be in Burt's dream too . . . But he supposed Burton would feel that his father might be jealous of Burt marrying me . . . and might be mad at his son . . . even think of killing him . . . And Burton (6/4)

would leave his father out of the dream . . . He'd be afraid to have him in.

FA: Yes, it would be only natural for Burt to be jealous of me. . . . But I'm not jealous. . . . Burton can dream about me anytime . . . in any way he wants . . . I won't mind . . . I don't mind if he dreams of marrying you, Edna. . . . I want my son to love you. . . . And I understand about how little boys love their mothers . . . And how they might even take their fathers as rivals . . . though I don't feel like a rival of my son . . . Burton can love you, Edna, in his way . . . and I, in mine . . . if Burton can once understand this then he won't be afraid of . . ."

The underlining in the accompanying script shows which lines were reacted to. The numerator of the fractions is the session number; the denominator, the time reading number. For example, 6/2 means the sixth session and the second time the script was read in that session.

". . . as soon as I have breasts like his mother's . . ." and shouted, "I don't have enough lunch."

Patient 28, during the reading of a script in which she suffocated her father by stuffing something down his throat, awoke on the line, "Choke him with it," and reached into her own mouth exclaiming, "I can't get it out of my mouth!"

3. Wake-up periods, especially in their early parts, sometimes contain actions and utterances extremely suggestive of the material just read to them. Patient 34, given his father's approval for getting away from his mother's overrestrictive moral codes, with lines such as, "I'm your dad . . . and we can chat together . . . drive away from mother's moral code together," awoke to say, "That's what I meant . . . patients. . . . The moral hospital up there. . . . They seem to get pretty good pretty fast." After scripts which gave patient 1 the love of his

mother with his father's full permission for it, he reacted midway through the wake-up period by saying, ". . . Peace deal . . . this deal here . . . the triumvirate."

4. The dream content, on the nights of treatments especially, sometimes seems clearly related to the scripts. Examples given later, under the heading "work done," illustrate this.

5. Frequent evidences occur that the patient actually operates in a childhood setting after hearing scripts. As previously noted, scripts are almost invariably written in terms of infancy or childhood. Patient 24, after hearing scripts relating to her birth and nursing, answered, on being questioned early in the wake-up period: "Dreams? . . . My daddy . . . gotta go out with daddy."

Patient 15, on the way home, while still affected by the drug and after hearing scripts relating to his birth, sang nursery rhymes. That night he told his wife the stories of "Red Riding Hood" and "The Three Bears."

EFFECTS OF THE PROCEDURE

1. *Specific Emotional Reactions to Scripts.*—Patients 23 and 33 reported a return of depression for the first time since treatment had begun directly after a mother-killing script was first read. One reported an accompanying gastrointestinal upset and a return of acne; the other, an upsurge in consumption of liquor.

After a weaning script, patient 29, immediately after the wake-up period, went into a rage lasting over two days because she interpreted an effort by one of us to hurry her so that she could catch a train as a move to deprive her of a chance to eat.

Patient 11, among whose symptoms were homosexuality and impotence with women, was given a script in which his mother's father justified his (actual) running away from home in childhood—both to escape his mother's beatings and to punish her for beating him. The grandfather also scolded and instructed the mother in the script. The patient awoke enraged. He spent the evening with a girl of whom he was fond, found that he wanted to hurt her, abused her verbally for one and a half hours and then had his first orgasm with her. This led to regular sexual relations with her, accompanied with a gradual decline of homosexual urges to nearly zero. Fantasies of stabbing the girl with a knife were sometimes associated with coitus for a considerable period. Some months after narcosis had ended the linkage of coitus with the need to hurt the woman began to recede, and it vanished after three extra, specifically designed narcosis sessions were given.

Such changes usually present a striking contrast to the emotional trends up to the moment of the patient's receiving the drug; they must result from something that happens after the drug has started to enter the blood stream. The physician maintains a friendly, interested attitude, giving encouragement if justified while preparing and injecting the medicament. Reactions to, and wishes concerning, the physician's attitude could determine emotions showing in the wake-up period, but rarely is there any evidence that they do. On the other hand, evidence

derived from the content of the wake-up period commonly and strongly suggests derivation from the scripts. These abruptly starting trends of emotion not only confirm the receipt of script material by patients; they also add to our knowledge of the patient's psychodynamic structure, of his specific problems and of his reactions to what we give him and of how we should design subsequent scripts.

2. *Specific Effects of the Procedures on Dreams and on Patterns of Feeling, Thinking and Behavior.*—Many changes in long-standing reaction patterns occur. The beginning of the change can often be timed accurately. As we have already stated, it often occurs specifically and definitely at some time after one session, but before the next; occasionally its beginning is sharply marked by the occurrence of a specific dream, sometimes on the night of treatment. At other times the change starts during a specific wake-up period.

In these instances the suggestion is especially strong that the change was precipitated specifically by the scripts just read. Even when one allows for the possibility that the precipitation could not have occurred except on the cumulative background of earlier sessions, the suggestion is still valid. More will be said concerning permanence of these changes; they seem to be beachheads which, once established, can usually be held. The definiteness with which both the time of change and the stimuli which presumably induced it often can be noted, seems striking.

Three examples are cited: (*a*) The sexual and associated developments of patient 11, whose case has been outlined, began while the drug effect was still present, after a very relevant script.

(*b*) Patient 26, aged 45, received a script in which his father expressed love and preference for him over a brother the patient had always hated and held in contempt; the father reduced the brother thoroughly and also described the patient as a warm, loving person, unlike his mother. That night the patient dreamed of helping his brother by "having the building codes put through in an amicable manner," accomplishing this by friendly negotiating with the opponents, instead of by demanding. The next day he saw his brother and "saw him as another human being for the first time."

(*c*) Patient 1, aged 21, had had lifelong envy and hostility toward his brother Jack, aged 25. For years the patient had felt under such strain as to avoid speaking to Jack unnecessarily. A focal point of envy was his brother's supposed muscular superiority as a child. When the patient was 6 years old, the brother appeared in a school play and, according to the patient, "the audience went into an uproar when he flexed his left arm." This made the patient, who was a spectator, shrink with envy and humiliation. He never forgot the incident. The true story was that the audience roared with laughter at the brother's

puniness when he shook his left fist at his "son," who was older, taller and huskier. This had never been explained to the patient, whose shame had prevented his making the matter known.

A script was given in which the patient's early school teacher said, " . . . and you and Jack will both have big muscles to flex." The patient reacted to this line by moving his left arm slightly. At his next session he reported a dream (the first he had remembered in a long time): "Something about my left arm—trying to lift it. Just that it was muscular . . . down . . . in a flexed position . . . very strange." Late in the wake-up period, when thinking and speech were nearly normal, he was reminded of having had a dream recently and said, "Oh, that was something about the arm. Yeah, something about the arm. Muscle flexed the arm . . . I don't know why I should suddenly get an urge to be very considerate about the family. Either I am going bugs, or I feel a change of viewpoint in you,[6] Doc." Doctor: "What is it?" Patient: "You asked me a couple of questions about Jack, and I've been longing to answer you." Doctor: "Well, explain yourself." Patient: "Well, how do I like Jack?" Doctor: "All right, what was wrong with the answer?" Patient: "I said he was a good kid. I always call him a good kid. My father used to be mad with him. That's how all the trouble started. I have a feeling for him."

The patient then wept and soon said, "I always called him a good kid and never meant it." Doctor: "Well, what are you trying to tell me? That you mean it now?" Patient shook his head affirmatively and said, " I think so. I hope so, too." Doctor: "You're laughing, Jim. What are you laughing at?" Patient: "I was thinking about the way you translate love."

From this point on the patient rapidly developed a feeling of fondness for Jack. He became aware of certain specific ways in which he was superior to Jack. Envy appeared again only once, at Jack's wedding, which occurred during treatment. The birth of Jack's son evoked feelings of pride and pleasure. The relationship ultimately became entirely realistic, with full realistic evaluation of Jack, disappearance of feelings of inferiority in relation to him and persisting affection (during a two and a half year follow-up).

Another factor may have helped to determine the new course of the patient's relations with Jack. Jim was the first patient treated, and the technic had not yet become standardized. We frequently continued wake-up periods for three or four hours, occasionally rereading parts of scripts. Sometimes the patient, then in a semiwaking state, would rise to Jack's defense when lines reducing him were read.

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6. Under the effect of the drug, patients often project their own feelings onto the examiner.

3. *Interim Phenomena.*—The reality of these changes is attested by interim phenomena, short-lived reactions occurring during periods of change. Usually these are emotions appropriate to the new patterns which are beginning to develop. Patient 23, for example, showed feelings of frustration, after gaining freedom to have a warm relationship with a man, when no appropriate man was known to her (fig. 2). Patient 32 showed fear for two sessions after gaining a feeling of independence from his father; this was considered appropriate under conditions in which, for the first time, the patient had to face a state of independence, even though it was what he wanted.

MANNER IN WHICH PATTERN CHANGES OCCUR

1. *Acceptance and Rejection of Script Material.*—Some workers have thought that therapy with amobarbital sodium operates hypnotically. Skoog,[7] in particular, gave positive suggestions to patients in a "twilight narcosis" produced by this drug and expressed the opinion that they accepted and responded to the suggestions.

Our own initial supposition was that patients accepted what was given them in the scripts and by doing so were able to drop habitual disturbing reactions. We thought, for example, that the receipt of quantities of love, especially via nursing, while in a transient state of "infancy" constituted an immense and highly satisfying wish fulfilment, as a result of which the patient, re-reared according to measure, could make a new start. We ultimately learned that, while this is sometimes the case, very often the situation is quite different and is probably not hypnotic.

A. Acceptance of Script Material: Acceptance of script material may be of two types. The theme may be accepted apparently completely, the acceptance exerting a strong effect on mood or emotion and sometimes leading directly to permanent changes in pattern (i. e., the heterosexual potency of patient 11). On the other hand, the patient may accept as true an idea in a script, but at the same time reject it as something which should continue; he may then get to work on it and change it (patient 30 and his father and grandfather, page 180).

B. Rejection of Script Material: On the contrary, patients frequently reject the script content completely; notably, this applies to certain cases in which parental love administered by script, or even by actual cuddling by the real mother as she reads, is rejected. We believe the background for this to be a literal disbelief by some patients that all this love can be genuine.

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7. Skoog, A. L.: Treatment for Neuropsychiatric Syndromes Employing "Twilight Narcosis," South. M. J. **28**:468, 1935.

2. *Work Done by Patients.*—Such rejections, however, do not leave patients inert. Nor do acceptances. In either instance patients usually appear to get to work on the problems at issue and to move toward solution of them.

This point is notable because the problems involved are ancient, if not lifelong, and solution attempted by conscious effort has not been possible before. Among the physiologic effects of the drug is an apparent change in brain organization of such a nature that an old problem presented to the patient by script has an exceedingly direct impact. In consequence, the patient can do new, rapid and direct work, in which the intellect participates, on the problem. When a patient rejects the script material, the love of a mother, for example, it seems to be done as though he were finally able to take a decisive stand regarding whether or not his mother had loved him, and to accept the decision. He stops wavering between wishing for it, on the one hand, and abandoning the quest in favor of independence of the whole problem, on the other. The importance of a problem which has always plagued the patient shrinks, and he becomes free to deal more maturely not only with the perplexing parent but with other aspects of life as well. He can define his own self better, seeing himself as an identifiable individual, as someone of his own rather than as the appendage of a problem. He may even develop more fruitful ways of dealing with the parent.

"Work done" means the performance of intellectual work. When a patient "does work" he changes his view of the problem. Oftenest the change is constructive—the patient may see several possible solutions and may choose one; he may see the problem itself as having a new and less frightening shape, and hence as easier to deal with; he may merely define the problem more fully and move toward resolution of it later. One patient, in studying her material, spoke of the freedom of choice a patient has in choosing new methods for attacking old problems.

Patients do work of this kind all through the narcosis series. Sometimes they deal with script material in novel or original ways not directly suggested by the scripts, as in example B, to follow.

Not every effect of scripts occurs with signs of the doing of work by the patient. Some appear to be direct effects on emotions, and some are probably abreactive; work may be done then, too, but evidence of it is lacking. Effects of this kind can still be lasting, as with the heterosexual potency of patient 11. Sometimes the work is not done immediately, but after several sessions of struggle (patient 28, page 180). Some examples of work done by patients, particularly after rejection of script material, are cited.

A. Work Done with Rejection of a Script: Patient 29 received a script in which she killed her (actually) brutal mother, who had habitually screamed at and beaten her. A surviving mother was not presented in

this instance. The patient rejected the script theme as a solution to her problem and adopted another approach. She did work not only by restoring her mother to life in a dream but by doing it according to her own (the patient's) specifications. Part of the script was: Father: "Go ahead, Jane . . . choke her . . . squeeze her neck between your fingers. . . . She's dead! . . . At last! . . . That rotten, screaming mother is dead . . . . She'll never beat you again. . . . Sure, you can put her in a grave . . . with water coming up out of it. . . . And now the water is coming up, covering your mean mother." The following is the major portion of a dream that night: "Talking to my real mother. . . . I was asking her questions in a commanding voice. . . . She was using sign language or else shaking her head for an answer of 'yes' or 'no'. . . . I asked her if she would be able to talk soon. I received the answer, 'Yes' . . . My mother was in a gray-brown cloud [possible use in the dream of the script statement concerning water in the grave] . . . up high. . . . She was smiling and had her hands folded peacefully. I felt strong because she couldn't talk, but at the same time I wanted her to. . . . She was very serene."

B. Acceptance of Concepts Given in Scripts, But Rejection of Them as Something Which Should Continue: Patient 30 received a script in which his father explained his (actually) many shortcomings as a father and difficulties in relating himself to other people happily. The explanation was in terms of chronic abuse he had received as a child from his own father. That night the patient dreamed: "There was a death in the family, I don't know whose." The patient's parents and brother were present and alive in the dream. "Next morning I found myself thinking of my paternal grandparent, but I don't know for sure if the words occurred in the dream."

The patient did work by establishing the death of (supposedly) the offending grandfather. The idea was the patient's; it had not been in the script. This point marked the beginning of some affection for and understanding of his father as a human being by the patient, whose previous attitude had been resentful and contemptuous.

C. Rejection of Scripts for Several Sessions, with Ultimate Solution by Doing Work: Patient 28 did not do the work immediately, and the result was deferred. In pretreatment and for the first four sessions, the patient showed so great a neurotic fear of her father that she could not even go to a public place with him, much less stay in a room alone with him. Her dreams customarily depicted him as an ogre-like figure, from whom she had to flee. In session 4, the scripts thoroughly reduced and killed the father, whereupon the neurotic fear was sharply decreased. In sessions 4 to 8, the scripts suggested a warm, loving relationship with a gentle, understanding father, with mother's approval. The patient

regularly rejected this material, and interim phenomena appeared—strong evidences of frustration and a frantic desire for love and acceptance from us. Ultimately work was done in the form of a final, complete renunciation of script material with resolution of the problem, as though the patient had at last stopped debating her relationship to her father, had come to grips with the problem and had found a solution. After the eighth session, she dreamed: "I looked up at Dr. Brickner from the amytal position and asked him what to do about my 'difficult parents.' He said, 'Let them go.'"

Reduction and killing of the father marked the apparent beginning of the change, with an immediate sharp reduction in fear; whereas two lines had been required in the table to contain all the notations of fear, references to it promptly became occasional (fig. 4). With this dream, rage and feelings of inferiority and guilt also waned sharply, and all these reactions ultimately became sparse. Feelings of well-being and independence and a general freedom to function in life commenced as trends which proved to be permanent. Conscious insight began to appear. Several months later the patient had two extremely difficult ordeals,

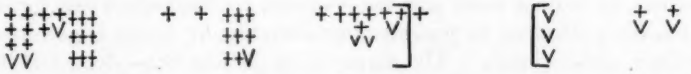

Fig. 4.—Drawing from chart of patient 28 to show change in number of evidences of fear. At first, two lines were needed to contain all the references; later, the references became few, and most of these indicate, not fear per se, but a reduction in fear (as shown by the inverted caret, meaning reduced). The symbols actually used in the chart have been changed to the plus sign and the inverted caret, for the sake of clarity in reproduction. Sessions 5, 6, 7, 8 and 9 are shown.

both of which she faced with the exercise of mature judgment, with some tension, which we thought the situations called for, and without recurrence of the old trends. An old dependence on alcohol also did not return (one year follow-up).

The fact that patients actually do work on their problems when under the influence of the drug has escaped notice heretofore. It became evident from the particular type of study which we set up. The pioneer studies of Bleckwenn,[8] soon followed by those of Lindemann,[9] were fairly well limited to establishing the dramatic influence the drug itself may exert on the course of mental illnesses. Bleckwenn attributed the results to the beneficent effects of sleep and rest; Lindemann, to the removal of inhibition. Other authors have followed these two theories,

8. Bleckwenn, W. J.: Narcosis as Therapy in Neuropsychiatric Conditions, J. A. M. A. **95**:1168 (Oct. 18) 1930.

9. Lindemann, E.: Psychological Changes in Normal and Abnormal Individuals Under the Influence of Sodium Amytal, Am. J. Psychiat. **11**:1083, 1932.

the latter in particular. Horsley [10] employed barbiturates for "narco-analysis," acquiring from narcotized patients material which he later used in waking therapy. Hoch,[11] working on the same principle and carefully employing the material evoked with the aid of the drug, developed this technic to a high point. The work of Sargent and Slater [12] and of Grinker and Spiegel [13] during the recent war was of entirely another order. Working with acutely disturbed soldiers, they used amobarbital sodium and thiopental sodium (pentothal® sodium) to produce abreaction under carefully studied conditions, with notable success.

The question arises whether the doing of work may not have played an important part in the therapeutic results obtained by others, with the possible exception of Sargent and Slater and Grinker and Spiegel, whose patients were of a type wholly different from other groups.

D. Lack of Consciousness of Work Done by Patients: Rarely, a patient has a vague, somewhat incorrect, memory of a line or two of a script. He may wonder over it or react to it consciously. With these exceptions, patients have no conscious knowledge of what initiated the moods or reactions of which they are sometimes aware after a session. Patient 39 remarked that he had been depressed since his previous session; he did not know why but supposed we "had wired him for it." Also, the work done by patients after activation by scripts is performed entirely unconsciously. The signs of its having been done and the descriptions of what has been or is being done are found in wake-up periods and in dreams, and sometimes in the changes in mood or reaction just mentioned.

These sudden alterations, and also the specific descriptions in wake-up periods and dreams of the work being done, have struck us as clear evidence of potent psychologic activity which never touches consciousness at all.

Occasionally patients make the observation that suddenly and mysteriously various members of the family have changed, without appreciating the possibility that they are seeing the family through different eyes; this is not to deny that family attitudes may change once it is realized that the patient is seriously undertaking treatment, and

10. Horsley, J. S.: Narco-Analysis: A New Technique in Short-Cut Pyschotherapy: A Comparison with Other Methods; and Notes on the Barbiturates, New York, Oxford University Press, 1943.

11. Hoch, P. H.: The Present Status of Narcodiagnosis and Therapy, J. Nerv. & Ment. Dis. **103**:248, 1946; Narcodiagnosis and Narcotherapy in the Neuroses and Psychoses, New York State J. Med. **47**:2694, 1947.

12. Sargent, W. W., and Slater, E. T. O.: An Introduction to Physical Methods of Treatment in Psychiatry, Edinburgh, E. & S. Livingston, 1948.

13. Grinker, R. R., and Spiegel, J. P.: War Neuroses in North Africa: The Tunisian Campaign (January-May, 1943), New York, Josiah Macy Jr. Foundation, 1943.

especially if a family member has read scripts. Frequently patients themselves recognize no changes during the narcosis part of treatment, although they are clear to the family or to us.

E. Role of the Transference Situation: Patients react positively to the physicians and the staff, in the main. Often this can be seen to play an important role in the patient's progress, as would be expected. When it does, the moment at which it takes hold with dynamic significance can often be seen by examining the table. This is unlikely to occur gradually; it happens when the patient needs it and can put it to use. It is apt to occur, for instance, when the debate over the love of a parent is resolved with rejection of the parent as a loving figure; at that time the patient may need a substitute and use one of us for that purpose.

The transference reaction does not always reach levels of such significance. Sometimes it remains negative, and still the patient may go on to a successful conclusion.

PHYSIOLOGIC ASPECTS

Some well defined phenomena characterize the state induced by amobarbital sodium. They form a basis on which a physiologic interpretation may be attempted.

1. *Distortion of Time Sense and Sensory Perception in General.*—These distortions have long been known. The change in time sense appears before the injection is completed. Often patients are preoccupied with time during the injection and wake-up periods and keep trying to estimate its passage, almost always incorrectly.

2. *Amnesia.*—Almost all patients have nearly complete amnesia for what transpires during the state induced by the drug. Amnesia for the total experience is not surprising, for we have found that in the early parts of the wake-up period the patient cannot remember even a single thought for more than a short time. The thought may be gone before it can be completely expressed in a short sentence, and the patient cannot be reminded of it again. Statements tend to revolve around a given theme longer than a specific thought can be held. Sometimes this theme appears to center around the roots of whatever psychologic configuration is in operation.

Examples: Patient 27 evidently forgot the thought immediately, in this sequence, from the early part of her third wake-up period: W. H.: "Sleepy?" . . . Patient sits up . . . W. H.: "Well, how does it go?" . . . Patient: "As usual. 'Nothing ventured; nothing gained.' . . . Nothing happens. Or does it?" . . . W. H.: "What made you think of that?" . . . Patient: "Of what?" . . . W. H.: " 'Nothing ventured; nothing gained.' " . . . Patient: "What did you ask me? You asked me a question. You did, didn't you?"

Patient 32 remembered his thought for nine seconds (time elapsed from * to *) and possibly for the additional moment of J. H.'s second remark. Patient *"It was very uncomfortable that way" . . . J. H.: "It was very uncomfortable?" . . . Patient: "In the back seat of my folks's Buick."* . . . J. H.: "Tell me more, Tom. What was going on?" . . . Patient: "What was going on where?" . . . J. H.: "In your dream" Patient: "When?" . . . J. H.: "Just now. Just now, Tom! What were you dreaming?" Patient: "I wasn't dreaming a thing. You just woke me up when I was about to."

This same brevity of memory, or evanescence of thought, is frequently encountered in narcosynthesis interviews with large doses. The examiner may ask the same question several times in succession, each time receiving a different answer, as though the patient were unaware of having just heard or answered the question.

3. *Difference Between Patients' Symbols and Symbols of the Normal Waking State.*—Early in wake-up periods utterances are apt to be not only fragmentary but in symbols unintelligible to the patient himself when he reads them later, awake. (The various illustrations which we have chosen have lacked this symbolism because we wanted them to be clear in their own right, without interpretation by us; highly symbolic utterances must be interpreted to be intelligible.) They occur frequently, sufficiently so to be regarded as characteristic of the performance of the brain under heavy doses of amobarbital sodium. For example, patient 43 said in response to rousing: "Oh, Marian was . . . er . . ." W. H.: "What? Who was? Marian?" Patient: "Marian was, yeah." W. H.: "She was what?" Patient: "Well, she made a nice couple with . . . a cat." W. H.: "With who? With a cat?" Patient: "Yeah, the other cat shaped . . . straped . . . striped the way she is." W. H.: "Yes? Go on." Patient: "Uh-huh. She went Lucy . . ." W. H.: "She went what?" Patient: "Lucy if she doesn't talk."

4. *Associations.*—Associations remain fixed on one symbolic level. When the utterances are in highly symbolic form, the associations at that time are similarly couched with little variation. If the statements are more nearly like those of a normal waking state, so are the associations in that segment of the wake-up period also without much variation.

The occasional variations are themselves of interest. A patient speaking in deeply symbolic language may suddenly make a brief remark in conventional terms and revert to the symbolic level.

We also have the impression that associations are few, compared with those of a normal waking state. This is hard to be sure of because we must rely on the patient's utterances and cannot tell what he may be thinking when silent. Theoretically, the amnesia supports this

possibility, perhaps indicating that thoughts do not become sufficiently linked with others to constitute a rememberable experience—thoughts remain isolated and are forgotten because they are not tied to anything.

HYPOTHESIS OF THE PHARMACOLOGIC DEMONSTRATION OF NEURAL NETWORKS WHICH ARE USUALLY OBSCURED

These characteristics of the state induced by heavy doses of the drug suggest that amobarbital prevents the brain from operating in its entirety. Evidently the activity of very many cortical networks is inhibited by the drug. Enough are inhibited, for example, to make impossible the comparisons essential for measurement of time. Lindemann first suggested that the drug inhibits the action of some elements of the neural organization.[9] Lorenz, Reese and Washburne [14]; Thorner,[15] and others suggested that the various portions of the central nervous system are affected by the drug in the order of their phylogenetic newness. Himwich, Homburger, Marcesca and Himwich [16] concluded from metabolic experiments that thiopental sodium reduces metabolism of the cortex in particular and also "inhibits nerve function"; their observations do not exclude the possibility of a greater metabolic reduction in some parts of the cortex than in others. Swank and Foley [17] have shown that the electroencephalogram of dogs under amobarbital sodium narcosis could be brought back toward normal by oxygenation.

Of equal importance, however, is the fact that other networks still operate. Whether or not they function in their normal way we do not know. They operate on their own, so to speak, since so much of the cortex is inhibited.

Thus, the suggestion arises that the drug, by inhibiting the function of some networks, permits the exposure, or perhaps release, of others. This exposure or release can be accomplished with the drug repeatedly, predictably and under planned conditions. It should be possible to employ the situation to learn more of the properties of these networks and of their actual functions in various stages of life.

1. *Functions of the Impaired and of the Exposed Networks.*—The networks impaired presumably deal with the more complex integrations

14. Lorenz, W. F.; Reese, H. H., and Washburne, A. C.: Physiological Observations During Intravenous Sodium Amytal Medications, Am. J. Psychiat. **90**:1205, 1934.

15. Thorner, M. W.: The Psycho-Pharmacology of Sodium Amytal in Catatonia, J. Nerv. & Ment. Dis. **82**:299, 1935.

16. Himwich, W. A.; Homburger, E.; Marcesca, R., and Himwich, H. E.: Brain Metabolism in Man: Unanesthetized and in Pentothal Narcosis, Am. J. Psychiat. **103**:689, 1947.

17. Swank, R. L., and Foley, J. M.: Respiratory, Electroencephalographic, and Blood Gas Changes in Progressive Barbiturate Narcosis in Dogs, J. Pharmacol. & Exper. Therap. **92**:381, 1948.

of intellectual processes; they are probably networks involved in the processes of complex evaluation in ordinary life. Those exposed presumably have less complex integrative functions and have less to do with evaluation. They are concerned with simpler integrations, with less complex reasoning; they appear to deal more closely with basic patterns of behavior—patterns which, at their inception early in life, could not be integrated with the networks of a complete adult cortex, because this had not yet developed in fully functioning form; later such integration may have been impeded by repression. Possibly these basic patterns are even exposed in a shape somewhat resembling their form at their inception.

The situation coincides with general experience in such conditions as intoxications (notably by alcohol) and states producing delirium. In these states the patient's capacity for complete intellectual functioning is reduced, and attitudes and patterns emerge which had been controlled, suppressed or repressed.

2. *Hypothesis to Explain the Therapeutic Efficacy of the Procedures.*—Once the networks under discussion are freed from their usual linkage with the entire cortex, or are released by the inhibition of function of the rest of the cortex, they are in a condition to be reached more directly by incoming stimuli, unencumbered by the innumerable associated networks normally operative in a waking state.

When these networks, under these conditions, have once received cogent material, activation ensues. The observations of Wolf and Ripley [18] are relevant in this connection. These authors were able to reproduce an immediate attack of asthma in one patient and instantaneous edema of the nasal mucous membrane in another by speaking to the narcotized patient of factors important in the genesis of the symptoms. In other words, once a factor represented in these networks is activated, as by script or by relevant, specific comment, it activates another and produces a prompt result—a symptom such as an asthmatic attack, an abrupt change in mood or the doing of work toward resolution of a problem.

A hope among psychotherapists is to find a means of communicating, in adult life, with basic, unconscious attitudes and patterns more or less directly. This has been attempted by various workers, employing such means as hypnosis, hypnoanalysis and hypnagogic reverie. Release of feelings has been sought by these technics, and the emergence of material into consciousness encouraged, so that insight might be offered later.

The procedure described here appears to furnish a means of more or less direct communication with these attitudes and patterns. However,

18. Wolf, S., and Ripley, H. S.: Studies on the Action of Intravenously Administered Sodium Amytal, Am. J. M. Sc. **215**:56, 1948.

most of the basic work is done during narcosis, with little intensive therapy left for a later period in most cases.

After the communication is made, the patient is often able to move the problem toward solution by himself (work done). Perhaps he does this by using the material in cue form, similarly to the way in which people normally respond to noises which are cues for alarm, but not to routine sounds. Sleeping mothers who awaken to the baby's voice but sleep through other louder sounds are an example.

The patterns laid down in early years of life must be of tremendous variety. The networks for some patterns may be employed oftener or become more widely connected with the rest of the brain than the networks for others. Some patterns which would have been more profitable than others for adult life may be almost drowned out. Thus, a child may have perceived in its parents attitudes more hostile and threatening than loving and protecting and have developed preponderant patterns of fear and defensiveness; yet, presumably, there were also rudimentary tracings of more helpful attitudes.

The aim of treatment is to provoke the emergence of successful patterns by activation with properly designed stimuli. One purpose is to alter the balance between patterns in situ, so to speak. Then, even as the patient awakens, the newly preponderant ones may be able to enter conscious awareness; there they may be further revised and brought into consonance with current reality.

We have been assuming that the neural organization operative under the drug is an early organization, which became covered over as the person matured. This, if true, would help to explain the speed and efficiency of the work done by patients in resolving their problems. In that event the problems posed in the script would be received and dealt with by patients in something resembling the same childhood setting (neural and psychologic) as that in which the problems were first formed. Then we might suppose that with the return to function of the entire cortical organization as the patient awoke these problems could be promptly reviewed in terms of later experience; they could be seen in an adult instead of childhood light; a new type of integration between earlier and later patterns might rapidly develop.

We believe the process as a whole is not the same as that of hypnosis because patients so often reject the script material and do work of their own and because the effects are lasting. On the other hand, there are infrequent instances in which a lasting change seems to start as the result of direct suggestion.

3. There is a clinical similarity between wake-up productions and ordinary dreams. The same type of symbolism and the distortion of sensory perception and of time sense occur in both. The amnesia appears similar, except that it is more complete after the drug.

Dreams may, indeed, have as one of their functions the performing of just the kind of problem-resolving work we have been describing, the problem being posed by the patient himself instead of by scripts, at a time when the brain is conceivably in a physiologic state similar to that produced by amobarbital sodium.

THERAPEUTIC RESULTS

Patients have been divided into three diagnostic categories: (1) psychoneurotic and maladjusted, (2) borderline and (3) psychotic.

The therapeutic results have been evaluated by two standards: changes in symptoms, and changes in general capacity to function in the world and to deal with life situations. A grade for each patient is arrived at by combining the two evaluations.

Patients whose scores are reported here have had at least one year of follow-up observation. The amount of improvement is graded as follows: slight, 1; moderate, 2; marked, 3; very marked, 4 (table 1). Grade 1 is assigned to patients in whom a change has occurred in one or two symptoms, but whose capacity to function freely with others and to deal with problems in general is unchanged. Grade 2 is given patients who have lost or had a reduction in enough basic symptoms that a distinct improvement has occurred in their general ability to meet situations, in relations with others and in general functioning in society; these patients, however, still have important symptoms, or a sufficiently strong residual impact from some which have been reduced, so that a ceiling on their social capacities remains. Grade 3 is given patients who have only slight residual psychoneurotic incapacity and who have shown a quite complete reorganization of personality. Grade 4 is assigned to patients who have apparently lost all their symptoms and are living as fully and happily as their talents and circumstances permit, having experienced a radical reorganization of personality. When there was doubt about a grade, we assigned the lowest which could be considered.

Four patients were impossible to grade. Two of them did lose many symptoms and improved in adaptation to life. Patient 27, with periodic depressions, had a recurrence a few months after the narcosis treatment ended. Another (patient 12, aged 45) entered his first depression, possibly involutional, several months after narcosis therapy. The depressions may have been of interim nature, associated with new insight and a newly realistic way of facing certain situations, but we cannot be sure. Patient 7, who still showed tension when treatment was begun, one and one-half years after an acute schizophrenic episode, went into another acute psychotic state just after the last narcosis session and shock treatment was required. Her decided psychologic improve-

ments became established only after the shock therapy was completed. For patient 4 the symptomatic picture before and after treatment was too confused to permit evaluation.

Fifteen [19] patients had psychologic tests before and after treatment. We have attempted to score the psychologist's qualitative descriptions of improvement according to our own quantitatively oriented grading system. For 8 patients the two estimates were about the same. We credited the patient with less improvement than the psychologist in 3 instances and with more in 4. Of the latter, the difference in 2 (patients

TABLE 1.—*Scoring of Therapeutic Results* *

Grade	0	0-1	1	1-2	2	2-3	3	3-4	4
Psychoneurotic Patients									
Number of patients (total 12)	0	0	0	1	0	4	4	1	2
								58%	
							91%		
Incapacity before treatment									
Marked	..	..	..	..	..	2	2	1	..
Moderate	..	..	..	1	..	2	1	..	1
Slight	..	..	..	..	..	..	1	..	1
Previous									
psychoanalysis	..	..	..	..	..	..	..	..	1
prolonged psychotherapy	..	..	..	..	..	1	..	..	..
Patients with Borderline States									
Number of patients (total 11)	0	1	0	3	3	1	1	0	2
								27%	
							36%		
Incapacity before treatment									
Marked	..	1	..	1	2	1	..	..	2
Moderate	..	..	..	2	1	..	1	..	..
Previous									
psychoanalysis	..	..	..	1	2	..	..	..	1
prolonged psychotherapy	..	..	..	1	1	1	1	..	..
Psychotic Patients									
Number of patients (total 3)	1	0	2	0	0	0	0	0	0
Incapacity before treatment									
Marked	1	..	2	..	..	..	..	..	..
Previous									
psychoanalysis	..	..	1	..	..	..	..	..	..
psychotherapy	1	..	..	..	..	..	..	..	..

* An estimate of the pretreatment degree of incapacity of each patient to function fruitfully in his work and in his relationships is included so that the degree of improvement may be contrasted with the patient's condition before treatment. The percentages probably lack statistical validity; they are to be considered as estimates.

19 and 28), and to some extent in a third (patient 25), is explained by the fact that the clinical grade refers to the patient's state of improvement at the time of this report, after waking treatment subsequent to narcosis. The psychologic tests, on the other hand, were given just before history taking and immediately after the termination of the narcosis series; hence, whatever changes they indicate must have

19. Sometimes the second series had to be excluded, and sometimes the first and second series had to be given by different psychologists and were not comparable.

occurred during the history-taking or the narcosis period. We have seen no definite evidence of change after the period of history taking with the possible exception of patient 26, who gained some insight from the process of history giving.

In 12 cases the intelligence quotients were measured by the Bellevue-Wechsler test before and after treatment (M. Harrower). In 7 they rose between the two tests, some notably, as shown in table 2.

These increases in the intelligence quotient must represent reduction of a blocking which was operative during the first test. General improvement was satisfactory in only 3 of these cases. All but patient 26 had borderline states.

PERMANENCE OF IMPROVEMENT AND BRIEF RECURRENCES AND RELAPSES

Permanence.—In the main, improvements, once begun, have become established. This applies both in general and in detail. As previously

TABLE 2.—*Intelligence Quotients Before and After Treatment*

Case No.	Intelligence Quotient		Increase in Intelligence Quotient	Clinical Grade of Improvement
	Before Treatment	After Treatment		
22	96	101	5	0-1
27	109	116	7	Unevaluated
15	124	132	8	1-2
26	125	133	8	3
24	104	121	17	1-2
29	88	107	19	2
28	104	127	23	4

stated, the time at which lasting change began can often be distinguished accurately.

Brief Recurrences.—Not infrequently patients who are doing very well have a sudden reemergence of all their symptoms, usually under specifically provocative conditions, and all within a short time after the narcosis series. The longest duration of these recurrences has been two days, and the patient usually has employed the occasion for the gaining of insight.

Relapses.—Relapses of a more serious import occurred in 5 patients. These were among the 15 patients who had achieved grades better than 2. Two had borderline states; 2 (both psychoneurotic) were over 40 years of age. The results for 2 patients (12 and 27) have been mentioned as impossible to evaluate at present; as previously stated, we are not sure that the depressions represented relapses. The third (patient 26) became depressed sometime after narcosis; but, on emerging from the depression, he promptly revealed again the excellent improvement he had shown directly after the narcosis. The fourth (patient 29)

had a prolonged incomplete recurrence of all her symptoms and again showed improvement, but not to her original level of gain. The fifth (patient 2) had a sufficient reduction in homosexual urges to permit his restraining them easily for about a year, after which the urges returned to their old level (two and a half year follow-up period). The patient was not seen during the second year.

One patient (patient 6, aged 28) failed to hold all his gain, although he retained most of it. He had had a severe obsessional neurosis. He was free of obsessive thinking for some weeks after narcosis; then it returned to about one third the old level, with occasional pronounced rises and falls. At the same time he maintained fully the general personality reorganization he had gained, including especially liberation from his mother, a realistic appraisal of the significance of love and of his relationships with other people and loss of extreme left wing attitudes, which had developed years before as part of his identification with his radical mother.

PROGNOSIS IN VARIOUS TYPES OF PATIENTS

We cannot speak of prognosis with assurance; we can, however, summarize to a certain extent the outcome in relation to age and diagnostic groups.

TABLE 3.—*Outcome of Amobarbital Treatment According to Diagnostic Group*

Grade	2-3	3 and 4
Psychoneurotic patients (total 12)	4	7
Borderline patients (total 11)	1	3

Psychoneuroses, Borderline States and Psychoses.—In general, patients with psychoneuroses fared better than those with conditions diagnosed as borderline states or psychoses (tables 1 and 3).

The patients with frank psychoses were schizophrenic. Patient 17 made no therapeutic gain at all. Patient 13 (grade 1) showed a lasting reduction in sexual anxiety and in hostility toward his family. These specific changes were of interest because of their contrast with the fixed, undeviating schizophrenic process. Patient 9 (grade 1) became clearer intellectually and also formed a strong transference reaction, which made possible later superficial psychotherapy, with some success; the underlying schizophrenic reaction remained unchanged (two year follow-up period). The results for patient 7 have been already discussed as impossible to evaluate.

Older Patients.—Of 3 patients over 40 years of age, the improvement in 1 (patient 8) was graded as 1-2; the outcome for patient 12

could not be evaluated. Patient 26 had a depression subsequent to the narcosis series, but his decided gains were still manifest after the depression passed.

ADVANTAGES OF THE PROCEDURE

We believe that the procedure has four major advantages.

1. Applicability to cases which present extremely difficult therapeutic problems. Most of the patients, including those whose improvement was graded 3 and 4, had for many years been heavily involved in dense, complex psychoneurotic states. The majority had been incapacitated to a greater or less degree in their relationships and in their ability to function productively in their work or in general (table 1).

2. Brevity of the period in which the basic part of the therapy is completed. Most of the intensive and basic part of the therapy was completed within the two months of narcosis. This statement is based on clinical observation and on the results of the psychologic tests in 15 cases.

TABLE 4.—*Improvement Grades According to Psychologic Tests*

Test Grade	1	1-2	2	2-3	3	3-4	4
	Psychoneurotic Patients						
Case no.	18	25†	11†	..	10	..	23
	..	..	..	..	26	..	..
	..	..	..	..	21	..	..
	..	..	..	..	30	..	..
	Borderline Patients						
Case no.	19†	..	22‡	15‡	5‡	..	..
	..	..	24	29†	..	..	..
	..	..	28	..	..	..	..

† Psychologist's estimate less than our clinical estimate.
‡ Psychologist's estimate greater than our clinical estimate.

The degree of improvement found by comparing the first and the second batteries of tests is an indication of how much of the therapy is accomplished in the narcosis phase. Table 4 summarizes the grades of improvement according to the tests.

Of 8 psychoneurotic patients, 5 achieved test grades of improvement greater than 2 prior to any waking treatment; of 7 patients with borderline states, 3 achieved this grade. These proportions coincide well with those in table 1, in which are listed clinical grades of improvement. One psychoneurotic patient (patient 11) and 2 patients with borderline states (patients 19 and 28) needed considerable to large amounts of waking treatment after narcosis, as previously indicated. Of the 6 patients without comparable tests before and after narcosis therapy but with grades of clinical improvement greater than 2, our clinical estimate is that 4 made all or most of their improvement under narcosis. One required a great deal of later waking treatment, and for 1 the issue is doubtful. Seven patients with grades higher than 2 had virtually no

waking therapy at all beyond the actual study of their material. Many patients had extensive postnarcosis waking therapy, including group work, but chiefly for the purpose of gaining general background and more detailed insight, and for the reenforcement and further development of trends which had started during the narcosis phase. Two patients later had additional narcosis for specific purposes.

3. Absence of resistance. With 3 exceptions, the factor of resistance has offered virtually no problem, either during the narcosis phase or later. There has been no occasion for choosing between battling with patients or going into sterile periods.

4. Specificity with which the patient's course can be followed. We have already described the specificity with which times of change, the effects of scripts on trends and the beginnings of changes in trends can often be noted.

UNCONTROLLED ASPECTS OF THE PROCEDURE

At least two factors in the procedure have not yet been adequately controlled. One is the effect of the drug itself; we do not yet know enough about its therapeutic effects per se in psychoneurotic states. Several authors have included psychoneuroses among the conditions improved merely by a succession of administrations of the drug. Heldt [20] has given detailed information concerning psychoneurotic patients who showed pronounced improvement after the production of a toxic delirium with amobarbital sodium, with little subsequent psychotherapy. In our own series, as in that of Hoch and others, the first administration of the drug is often followed by euphoria, which usually does not recur.

Despite the possible therapeutic action of the drug itself, we believe that the procedure described is specific in its effects. This statement seems justified by the evidences of a specific temporal and substantive relation between scripts and ensuing events, as previously described.

If our conception of "work done" is correct, it is likely that some patients could do work themselves, aided by the drug but without scripts. However, without scripts the patient would lack the direction given by the presentation of a distinct problem to work on and the ensuing freedom of choice of ways of attacking that particular problem, and the physician would lack specific knowledge of what was happening.

The other major uncontrolled factor is the concentrated and friendly attention each patient receives during the narcosis series. The patient knows that four people are thinking, conferring and working concentratedly on him. This assurance can hardly be credited with the whole therapeutic result, although it may well be a factor. This aspect is difficult, if not impossible, to control completely.

20. Heldt, T. J.: The Therapeutic Use of Prolonged Sodium Amytal Narcosis, Am. J. Psychiat. **104**:27, 1947.

Each single part of the procedure should be carried out separately in numerically significant groups of patients. One group should be given no postamobarbital waking therapy at all. Several types of electroencephalographic studies are also indicated, and have been commenced. Facilities are being arranged for the study of other factors, by which it may be possible to learn more of the physiology of therapy.[21]

SUMMARY

A psychotherapeutic method is described which utilizes directly certain neurophysiologic factors.

Amobarbital sodium (amytal® sodium) is administered intravenously, and a series of subsequent steps is systematically employed.

The drug induces a certain physiologic state; this state is discussed; we believe it can be understood to a certain degree. When the brain is in that state, specific psychologic impacts often can be made with unusual directness. Frequently this results in unusually rapid psychologic changes.

Usually these psychologic changes appear to be unlike those of hypnosis. During the procedure patients frequently reject material which is given them and seem to be prompted to do quick, direct work of their own on the solution of their problems. Sometimes this work has an original quality. Moreover, psychologic changes, once made, are usually lasting.

Occasionally patients do respond to the material given them as though to direct suggestion, but under these conditions also the changes are lasting.

The reenforcement many patients obtain during postnarcosis waking therapy may help in establishing the permanence of changes made during narcosis.

Responses suggestive of abreaction occur occasionally.

Patients with at least one year of follow-up observation showed the following therapeutic results: Of 12 patients with psychoneuroses, all but 1 showed improvement graded as better than moderate, and more than half showed improvement graded as marked or very marked. Of 11 patients with borderline states, 4 showed improvement graded as better than moderate, and 3 showed improvement graded as marked or very marked.

On the whole, the bulk of the intensive psychotherapeutic work is completed under narcosis. Most psychoneurotic patients who have responded well under narcosis require virtually no thorough waking

21. At the time of writing the work of C. R. Elliott was not available to us (An Experimental Study of Retention of Auditory Material Presented During Sleep, master's thesis, University of North Carolina, 1947; microfilm available). A full review of the literature will appear in another communication.

therapy. A greater amount of waking therapy is sometimes needed with patients who have responded only fairly well, especially if they are in the borderline group.

The method has the following advantages:

1. It is applicable to cases which present extremely difficult psychotherapeutic problems.

2. The major and basic portion of intensive psychotherapy is usually completed in about two months.

3. Resistance is rarely encountered either during the narcosis part of treatment or during subsequent follow-up work.

4. Factors inherent in the process make possible a considerable degree of specificity and accuracy in following a patient's course, in evaluating the effects of therapy as it progresses and in planning steps as treatment advances.

1000 Park Avenue.

Dr. Charles Ressler, New York, gave unstinted assistance in this study.

RECENT CONTRIBUTIONS TO THE ANATOMY AND PHYSIOLOGY OF THE CEREBELLUM

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THIS PRELIMINARY review of the newer contributions to knowledge of the cerebellum is limited primarily to those which have appeared during the past decade. As background material, very brief mention will be made of the most significant early work, but an unwieldly paper would result if a comprehensive coverage of the many articles which have been published on the clinical and basic aspects of this subject were attempted. For more detailed information on the subject up to approximately fifteen years ago, the reader is referred to such splendid reviews as those by Ariëns Kappers, Huber and Crosby,[1] Jakob [2] and the *Proceedings of the Association for Research in Nervous and Mental Diseases* [3] for 1926.

It is probably fair to say that the history of modern physiology of the cerebellum begins with Rolando,[4] who, in 1809, studied decerebellectomized animals and introduced two functional concepts which are still accepted today; i. e., (*a*) destruction of this organ produces disturbances in posture and voluntary movement, and (*b*) there is no loss of conscious sensation. A few years later, Flourens [5] pointed out that staggering gait and lack of muscular coordination should be added to the

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1. Ariëns Kappers, C. U.; Huber, G. C., and Crosby, E. C.: The Comparative Anatomy of the Nervous System of Vertebrates, Including Man, New York, The Macmillan Company, 1936.

2. Jakob, A.: Das Kleinhirn, in von Möllendorff, W.: Handbuch des mikroskopischen Anatomie des Menschen, Berlin, Julius Springer, 1928, vol. 4.

3. Tilney, F.; Davis, T. K., and Riley, H. A.: The Cerebellum, A. Research Nerv. & Ment. Dis., Proc. (1926) **6**:1-649, 1929.

4. Rolando, L.: Saggio sopro la vera struttura del cervello dell'uomo e degl'animali e sopra le funzioni del sistema nervoso, sassari, Stamperia Privilegiata, 1809; cited by Fulton, J. F.: Physiology of the Nervous System, New York, Oxford University Press, 1943.

5. Flourens, P.: Recherches experimentales sur les propriétés et les fonctions du système nerveux dans les animaux vertébrés, Paris, Crevot, 1824; cited by Fulton, J. F.: Physiology of the Nervous System, New York, Oxford University Press, 1943.

"cerebellar syndrome." He also introduced another functional concept of considerable importance: The cerebellum functions as a whole; i. e., there is no functional localization within it.

The next significant advancement came approximately seventy years later, when Luciani,[6] after a comprehensive analysis of motor deficiencies resulting in dogs and cats after ablation of the cerebellum, introduced his now famous triad: asthenia, atonia and ataxia. Luciani also agreed with Flourens' concept that the cerebellum functions as a whole.

Further support for the unitarian concept of cerebellar function came from the masterful anatomic works of Golgi [7] and Ramón y Cajal,[8] who demonstrated that, unlike the cerebral cortex, the cerebellar cortex was rather simple morphologically and possessed a remarkably uniform structure throughout its various folia.

Sherrington,[9] in his analysis of the mechanisms involved in the control of posture, not only supported the unitarian concept of cerebellar function but, as a result of his studies on the cerebellar influence of muscular coordination, introduced the well known phrase, "head ganglion of the proprioceptive system." Then followed Magnus [10] and Rademaker,[11] who made thorough and scholarly analyses of muscular and postural dysfunctions in animals following cerebellar ablation and also supported the unitarian concept of cerebellar function.

One must not leave this hasty historical review without mentioning one or two well known dissenting voices to the widely accepted belief that the cerebellum "functions as a whole." The most ardent dissenter was Bolk,[12] a comparative neurologist, who in 1903 studied in great detail the configurations of the cerebellum in animals with a wide variety of genetic structural differences. To cite a familiar example, he noted a large lobulus simplex in the giraffe and therefore concluded that this lobulus functioned to coordinate the muscular activity of the neck. In this way he assigned functions to most of the lobuli of the cerebellum. Bolk's concepts were expanded by the great Netherlands

6. Luciani, L.: Il cervelleto: Nuovi di fisiologie normale e patologica, Florence, Le Monnier, 1891.

7. Golgi, C.: Untersuchungen über den feineren Bau des centralen und peripherischen Nervensystems, Jena, Gustav Fischer, 1894.

8. Ramón y Cajal, S.: Histologie du systéme nerveux de l'homme et des vertébrés, Paris, A. Maloine, 1909-1911.

9. Sherrington, C. S.: The Integrative Action of the Nervous System, London, Charles Scribner's Sons, 1906.

10. Magnus, R.: Körperstellung: Experimentell-physiologisch, Berlin, Julius Springer, 1924.

11. Rademaker, G. G. J.: Das Stehen, Berlin, Julius Springer, 1931.

12. Bolk, L.: Das Cerebellum der Säugetiere: Eine vergleichend anatomische Untersuchung, Haarlem, Gustav Fischer, 1906.

physiologist Rijnberk,[13] who performed an extensive series of ablation studies on animals and found centers for the control of movements of the head and neck in the lobulus simplex, for the upper extremities in crus I and for the lower extremities in crus II.

Thus, two schools of thought arose; one, largely following Bolk's ideas, maintained that there was functional localization and the other believed that the cerebellum functioned as a whole. Both groups agreed that the primary function of the cerebellum was the coordination of muscular activity, with special emphasis on afferent connections with proprioceptor endings. During the era of 1930 to 1940 there was a growing tendency to question the unitarian concept of cerebellar function.

AFFERENT PROJECTIONS OF THE CEREBELLUM

The work of Stowell and myself [14] began in the fall of 1941, when it was realized that clinicians had long held that certain tactile functions passed through the gracile and cuneate nuclei on their way to the thalamus and that many anatomists had long believed that these nuclei were connected with the cerebellum by arcuate fibers. Thus, there was a theoretic possibility at least that there existed a tactile projection to the cerebellum. Much to our surprise, the theory held when put to experimental test.[15] Figure 1 is included largely for its historical interest, since it shows for the first time that tactile areas exist within the cerebellum and that there is a localized projection to these areas. This figure is included for another important reason; i. e., not only does it answer definitely and finally the long-standing question of whether or not there is localization of function within the cerebellum, but it also abolishes the long-standing fallacy in the literature which limited the afferent supply of the cerebellum to the proprioceptive system, and thus introduces a broader concept of cerebellar function than has hitherto existed.

Figure 2 summarizes our work on the tactile areas within the cerebellum of the monkey.[16] It is to be noted that the anterior lobe area overlaps the lobulus simplex and is an ipsilateral projection, whereas the paramedian lobules are represented bilaterally. It is also to be

13. van Rijnberk, G.: Les dernières recherches relatives à la question de la localisation dans de cervelet: anatomie, physiologie, clinique, Arch. néerl. de physiol. **10**:183-301, 1926.

14. Snider, R. S., and Stowell, A.: Evidence of Tactile Sensibility in the Cerebellum of the Cat, Federation Proc. **1**:82, 1942.

15. (*a*) Snider and Stowell [14]; (*b*) Receiving Areas of the Tactile, Auditory and Visual Systems in the Cerebellum, J. Neurophysiol. **7**:331-358, 1944.

16. Snider, R. S., and Stowell, A.: Electro-Anatomical Studies on a Tactile System in the Cerebellum of Monkey (Macaca mulatta), Anat. Rec. **88**:457, 1944.

noted that the two figures are oriented "heads together." The pathway or pathways involved have been studied, but not thoroughly enough to be included in this review.

Earlier, Dow,[17] by electrically stimulating the sciatic and saphenous nerves, recorded the presence of cerebellar potentials in essentially these same areas. Later, Adrian,[18] by means of stimulation of end organs (tactile), obtained results similar to ours.

The diagram shown in figure 2 was constructed on the basis of unequivocal tactile stimulation and introduced the interesting, but still unsolved, question: Where are the proprioceptive areas of the cerebellum? The difficulty of obtaining pure proprioceptive stimulation has prevented us from making an analysis of such areas. However, it was

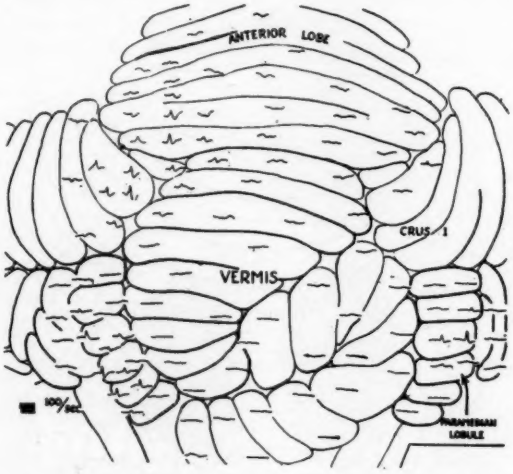

Fig. 1.—Tactile areas in the cerebellum for the forefoot of the cat, as mapped with the animal under pentobarbital anesthesia. Discrete movement of hairs was used as a stimulus, and electrical potentials (surface positive) were recorded from the pial surface. One responding area is in the posterior portion of the (ipsilateral) anterior lobe, overlapping the lobulus simplex and the medial part of crus I, and the other area is bilaterally represented in the paramedian lobules, overlapping the medial part of crus II. The area for the hindleg is anterior to that for the foreleg in the anterior lobe and posterior to it (with extensive overlap) within the paramedian lobule. These studies were carried out with minimal tactile stimuli.

evident from the beginning that pressure on a toe, for example, or the bending of the joint of a toe while the hairs about the same toe were simultaneously activated always resulted in a more vigorous cerebellar

17. Dow, R. S.: Cerebellar Action Potentials in Response to Stimulation of Various Afferent Connections, J. Neurophysiol. **2**:543-555, 1939.

18. Adrian, E. D.: Afferent Areas in the Cerebellum Connected with the Limbs, Brain **66**:289-315, 1943.

response in the area than did uncomplicated tactile stimulation. Thus, it is tempting to believe that the tactile and proprioceptive areas of the cerebellum are coextensive, at least in part. The results of the investigations of Dow and Anderson [19] and of Adrian [18] might be similarly interpreted. It is still not known whether it is the spinocerebellar fibers that carry these impulses. (See Brodal [20] for connections via the external cuneate nucleus.)

During an experiment in which the cerebellar tactile area of the face was being mapped, two waves from the pial surface, instead of the customary one, were observed. The latency of the first wave was 6 to 8 milliseconds, and the latency of the second was 10 to 12 milliseconds. Careful survey of the stimulating equipment revealed that

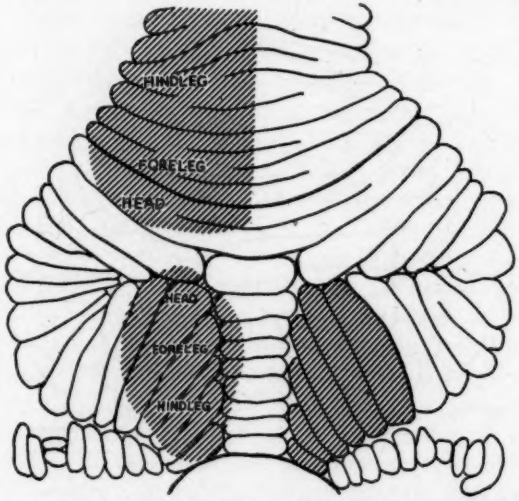

Fig. 2.—Tactile areas of the cerebellum of the monkey, as mapped by discrete movement of hairs on the left side of the animal. Note the bilateral area in the paramedian lobule and nearby folia and the ipsilateral area in the anterior lobe and lobulus simplex. Note also the subdivision of these areas for representation of the head, foreleg and hindleg. Representations for the trunk and neck have also been observed.

both auditory and tactile stimulation was unintentionally being used and had led to the discovery of the auditory area of the cerebellum.[21] Figure

19. Dow, R. S., and Anderson, R.: Cerebellar Action Potentials in Response to Stimulation of Proprioceptors and Exteroceptors in the Rat, J. Neurophysiol. **5**:363-372, 1942.

20. Brodal, A.: Die Verbindungen des Nucleus cuneatus externus mit dem Kleinhirn beim kaninchen und bei der Katze, Ztschr. f. d. ges. Neurol. u. Psychiat. **171**:167-199, 1941.

21. Stowell, A., and Snider, Ray S.: Evidence of a Representation of Auditory Sensibility in the Cerebellum of the Cat, Federation Proc. **1**:84, 1942; footnote 15b.

3 *A* shows the type of responses and the position on the pial surface from which these responses were recorded when "click" stimuli were used. Studies on the area using "pure tone" auditory stimuli were not made, nor were detailed studies on a "second" cerebellar auditory area. Figure 3 *B* presents the extent of the auditory area in the cat. This area was mapped in decerebrate animals with both fifth cranial nerves cut. To obviate the possibilities of vitiation of the results by stimulation of proprioceptor endings, the area was also studied in spinal animals in which the intra-aural muscles were destroyed. The responses could not be elicited after bilateral section of the eighth cranial nerve.

The question then arises: If tactile and auditory impulses pass to the cerebellum, how many other sensory modalities are represented there? Attempts have been made to find gustatory and olfactory areas, but without success. However, a visual projection to the cerebellum has been studied extensively.[22] As show in figure 4 *A*, visual responses have

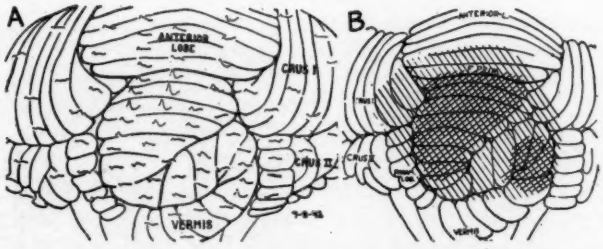

Fig. 3.—Auditory area of the cerebellum, as mapped with "click" stimuli.
A, surface-positive responses recorded from the pial surface of the cat cerebellum (chloralosane [o-chloralose] anesthesia). Note the two areas of maximal response. These responses were abolished by lesions in the region of the inferior colliculus.
B, outline drawing of the auditory area in the cat cerebellum, shown in diagonal lines. Areas of maximal electrical response are shown by cross hatching.

a latency of approximately 20 milliseconds, and the responding area is almost identical with that outlined as the auditory area. Thus, it is more accurate to call it an audiovisual area. The responses occur in the absence of the extraocular muscles and the eyelids, as well as after neodecortication. The projection is by way of the superior colliculus.[23] In figure 4 *B* is outlined the visual area in the cat. The explanation of the two, and occasionally three, zones of maximal responses is not known. It is pointed out that the visual and the auditory area are practically coextensive; this introduces the interesting, but still unanswered, question of why both the receptors for far stimuli project to the same

22. Snider, R. S., and Stowell, A.: Evidence of a Projection of the Optic System to the Cerebellum, Anat. Rec. **82**:448-449, 1942; footnote 15b.

23. Snider, R. S.: A Tectocerebellar Pathway, Anat. Rec. **91**:299, 1945.

cerebellar area. It is also interesting that this area in the region of the lobulus simplex extensively overlaps the tactile area for the face and neck (also, perhaps, proprioceptive). Thus, in this compact lobule are the receiving mechanisms necessary for reflexive turning of the head. As previously indicated, there also exists the possibility of extensive overlapping of the receiving areas of the receptors for near stimuli, i. e., tactile and proprioceptive receptors. One can rest assured that this extensive overlap of sensory areas is of considerable functional significance to the animal. The projection of the vestibular system to the cerebellum has long been known to be separate from these areas,[24] and will not be discussed at this time.

The question then arises: What is the function of these cerebellar areas? Why do tactile, auditory and visual areas exist within the cerebellum when they are so well represented within the cerebrum? Undoubtedly, it is true that they do not subserve any known conscious function.

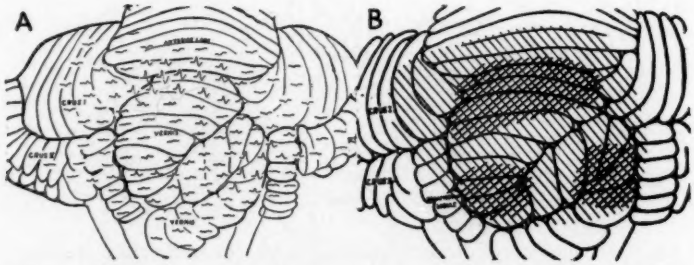

Fig. 4.—Visual area of the cerebellum, as mapped by photic stimulation. *A*, electrical responses recorded from the pial surface of the cat cerebellum (chloralosane anesthesia). Note that the responding area is coextensive with the auditory area (fig. 3). These responses occur in the absence of the extraocular muscles and the cerebral cortex.

B, outline drawing of the visual area of the cat cerebellum, shown in diagonal lines. Cross hatching indicates areas of maximal response. Although three such areas are shown here, it is not unusual to observe two of them fused together, thus resembling the auditory areas shown in figure 3 *B*.

It was thought that one way of learning more about the functions of these areas was to study possible cerebral connections to them. That such cerebral connections to the cerebellum do exist has been known for many years and will be considered at this point. Sunderland [25]

24. Larsell, O.: (*a*) The Cerebellum: A Review and Interpretation, Arch. Neurol. & Psychiat. **38**:580-607, 1937; (*b*) The Development of the Cerebellum in Man in Relation to Its Comparative Anatomy, J. Comp. Neurol. **87**:85-129, 1947; (*c*) The Development and Subdivisions of the Cerebellum of Birds, ibid. **89**:123-190, 1948.

25. Sunderland, S.: The Projection of the Cerebral Cortex on the Pons and Cerebellum in the Macaque Monkey, J. Anat. **74**:201-226, 1940.

reinvestigated the question of corticopontocerebellar connections and observed the frontal, parietal, occipital and temporal lobes sending fibers to the pons, and thence to the cerebellum, with little evidence of localization. Brodal and Jansen's [26] excellent anatomic study of pontocerebellar connections emphasized both paleocerebellar and neocerebellar connections and showed little evidence of a point to point localization. Dow's [19] study was the most complete electrical analysis made up to that time and, while showing some localization of projection, especially from cerebral area 4, emphasized widespread projections from the cerebrum to the cerebellum.

Adrian,[18] on the other hand, obtained localized projections from cerebral area 4 to the anterior lobe of the cerebellum to the extent of outlining areas for the face, arm and leg within the anterior lobe. It is interesting that these areas corresponded in detail to our [14] tactile area in the anterior lobe. The studies by Eldred and me [27] on a cerebrocerebellar projection and those of Hampson [28] were carried on independently, but the results are in complete agreement except for minor details. Figure 5 *C* and *D* summarizes the result of our studies on the cerebral projection to the cerebellum in the monkey. *A* (cat) illustrates that electrical activation of the auditory receiving area of the cerebrum produces responses within the lobulus simplex and folium-tuber complex of the cerebellum. *B* shows that area 17, or the visual receiving area of the cerebrum, also projects there. Thus, the so-called audiovisual area of the cerebellum receives impulses from both the auditory and the visual area of the cerebrum, and figures 3 and 4 show that this is the area which receives impulses initiated in both the retina and the cochlea. Also, attention is called to figure 5 *C*, which shows that area 4, or the motor area, and areas 3, 1 and 2, or the somatic receiving area, project to the anterior lobe, the lobulus simplex and the paramedian lobules in a way that is reminiscent of the projection from tactile end organs to the cerebellum (fig. 2). Thus, there is a dual projection to the aforedescribed cerebellar areas: one from the end organs, via intermediate synapses, and the other from related sensory and motor areas of the cerebrum.

The duality of these projections is emphasized in figure 6, which shows both systems impinging on the same cerebellar area. It is to be noted that both a cochlear and an auditory (cerebral) projection pass to the auditory (audiovisual) area of the cerebellum, that both a retinal and

26. Brodal, A., and Jansen, J.: The Ponto-Cerebellar Projection in the Rabbit and Cat, J. Comp. Neurol. **84**:31-118, 1946.

27. Snider, R. S., and Eldred, E.: Cerebral Projections to the Tactile, Auditory, and Visual Areas of the Cerebellum, Anat. Rec. **100**:82, 1948.

28. Hampson, J. L.: Relationships Between the Cerebral and Cerebellar Cortices in the Cat, Federation Proc. **7**:50, 1948; Relationships Between Cat Cerebral and Cerebellar Cortices, J. Neurophysiol. **12**:37-50, 1949.

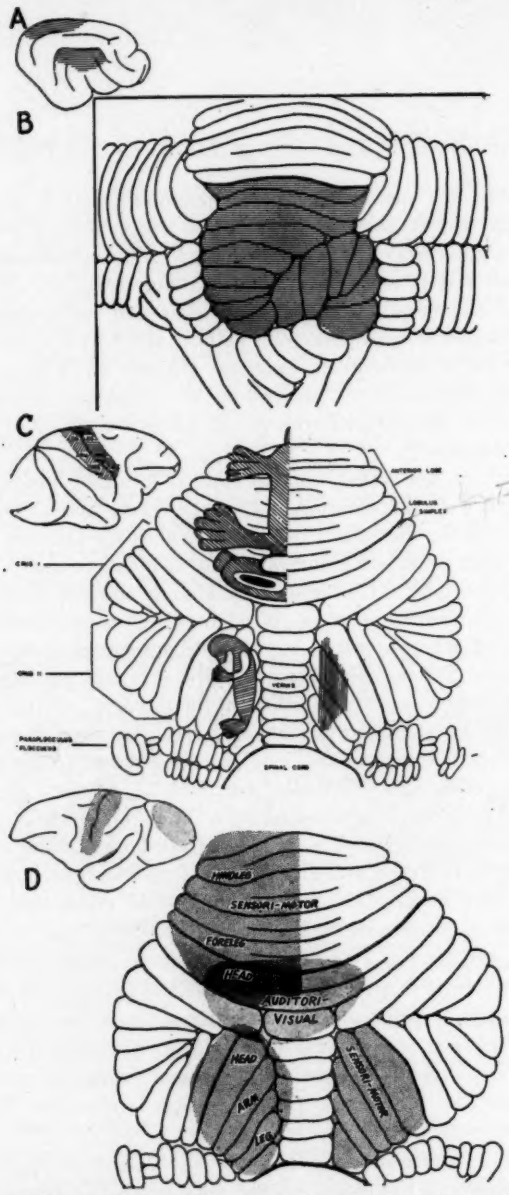

Fig. 5.—*A*, Electrical stimulation of the visual area of the cat (chloralosane anesthesia, single shocks, one millisecond's duration) initiated surface-positive responses within the audiovisual area of the cerebellum, as shown by horizontal lines. It is not unusual to observe responses in crus I and crus II; but since these areas are part of another projection system, they are not included here.

B, electrical stimulation of the auditory area of the cat (chloralosane anesthesia; single shocks, one millisecond's duration) initiated surface-positive responses within the audiovisual area of the cerebellum, as shown by horizontal lines. It is interesting that this is the same cerebellar area to which the cochlea projects. This chart summarizes the results of several experiments.

C, summary of projections from sensory area I and the motor area of the cerebrum of the monkey to various cerebellar areas (chloralosane anesthesia). Inconstant findings in crus I and II are not included. The responding cerebellar areas are almost identical with the tactile receiving areas.

D, summary of corticocerebellar projections in the monkey (Macaca mulatta; chloralosane anesthesia). Inconstant findings in crus I and II are not included. Sensorimotor projections are shown by coarse stippling, and audiovisual projection, by fine stippling. Note the head, arm and leg areas within the sensorimotor area of the cerebellum and the overlap of the head area with the audiovisual area.

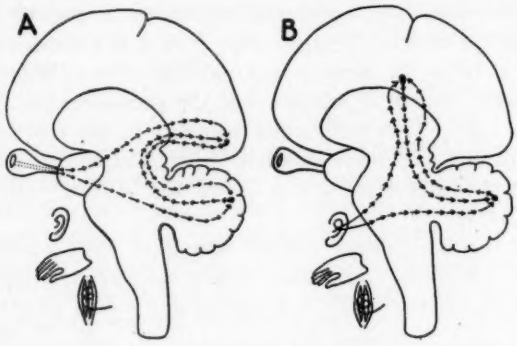

Fig. 6.—*A*, schematic diagram showing dual projection from the retina to the cerebrum—one pathway by way of the thalamus (lateral geniculate nucleus) and the other to the cerebellum and then upward. Note that the visual area of the cerebellum projects to the visual area of the cerebrum and vice versa. The cerebellar visual area receives two projections, one from the end organ and the other from the visual area of the cerebrum. Intermediate synapses not shown.

B, schematic diagram showing projection from the cochlea to the cerebral auditory area (intermediate synapses not shown) and from the cochlea to the cerebellar auditory area and thence to the auditory area of the cerebrum, which, in turn, projects back to the auditory area of the cerebellum; thus, a dual projection to both the cerebral and the cerebellar auditory area exists.

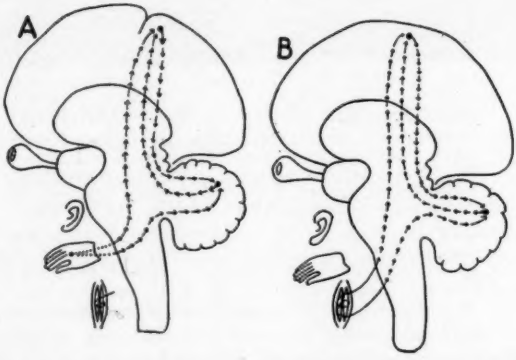

Fig. 7.—*A*, schematic drawing showing dual tactile projection from the periphery to the cerebrum, one pathway via the thalamus and the other via the cerebellum and thence to the thalamus. Intermediate synapses are not shown. The tactile area of the cerebellum projects to the tactile area of the cerebrum and vice versa. Thus, the tactile area of the cerebellum receives two projections, one from the end organ and the other from the cerebral sensorimotor areas.

B, proposed schematic diagram of the dual projection of the proprioceptive system to the cerebrum. Note the schematized interrelations of the cerebellar and the cerebral proprioceptive areas.

a visual (cerebral) projection pass to the visual (audiovisual) area and that both a tactile end organ (fig. 7 *A*) and a somatic (cerebral) projection pass to the tactile (sensorimotor) area of the cerebellum. The possibility of a dual projection of the proprioceptive system also exists (fig. 7 *B*). It is tempting to speculate on the function of these dual systems, but until more data have been collected it is probably not wise to say that it is more than a "check and balance" mechanism for cerebellar action.

Figures 6 and 7 further indicate that these same cerebellar areas project (via intermediate synapses) back to the cerebral receiving areas. This aspect of our work will be discussed in the next section.

EFFERENT PROJECTIONS OF THE CEREBELLUM

Connections of the cerebellar nuclei with the vestibular nuclei and with the thalamus have been known for many years, and the well controlled study of Jansen and Brodal [29] indicates localized projections from the cortex to the nuclei. Denny-Brown, Eccles and Liddell [30] demonstrated that stimulation of the cortex of the anterior lobe will reflexly inhibit or excite either flexor or extensor muscles in decerebrate animals. This clearly shows that the cerebellum can act on spinal structures but does not indicate the intermediate structures involved. Larsell's [24a] excellent study on the comparative morphology of the flocculonodular lobe and adjacent structures clearly demonstrates the relation of these structures to the vestibular nuclei. The most extensive study on the function of efferent projections of the cerebellum from the anterior lobe has been made by Moruzzi, first in relation to postural tone [31] and then in relation to cerebral function.[32] He has clearly shown that both inhibitory and excitatory effects on cortically induced movements can

29. Jansen, J., and Brodal, A.: Experimental Studies on the Intrinsic Fibers of the Cerebellum, Norske vid.-akad., math.-naturv. kl. **3**:3-50, 1942.

30. Denny-Brown, D.; Eccles, J. C., and Liddell, E. G. T.: Observations on Electrical Stimulation of the Cerebellar Cortex, Proc. Roy. Soc. London, s.B. **104**:518-536, 1928.

31. Moruzzi, G.: Ricerche sulla fisiologia del paleocerebellum: I. Riflessi labirintici e cervicali, paleocerebellum e tono posturale, Arch. di fisiol. **36**:57-112, 1936; II. Riflessi propriocettivi somatici, paleocerebellum e tono posturale, ibid. **36**:337-364, 1936; III. Sulla natura e sul meccanismo dell'inversione dell'inibizione paleocerebellare, ibid. **36**:408-427, 1936.

32. Moruzzi, G.: Sui rapporti fra cervelletto e corteccia cerebrale: I. Azione d'impulsi cerebellari sulle attività corticali motrici dell'animale in narcosi cloralosica, Arch. di fisiol. **41**:87-139, 1941; II. Azione d'impulsi cerebellari sulle attività mortrici provocate dalla stimolazione faradica o chimica del giro sigmoideo nel gatto, ibid. **41**:137-182, 1941; III. Meccanismi e localizzioni delle azione inibitrici e dinamogene del cervelletto, ibid. **41**:183-205, 1941.

be obtained by faradizing the anterior cerebellar lobe and that the effect which is exercised depends on whether the cerebral cortex is hyperactive or inactive in the motor sphere.

Figure 8 reproduces the results in two of Moruzzi's experiments and shows that stimulation of the anterior lobe can suppress strychnine-induced (cerebral) movements (*B*) or, if a subthreshold dose is administered, changes the subthreshold to a threshold effect (*A*). This result recalls Rossi's [33] experiment, in which subthreshold cerebral faradizations became threshold if the cerebellum was faradized at the same time. Our experiments [34] on cerebellar stimulation have shown not only that it is possible to suppress (fig. 9) and to facilitate (fig. 10) cortically, as well as reflexly, induced movement, but that the cerebellar areas which are most active are the lobus anterior–lobulus simplex areas and the paramedian lobules. By careful use of threshold stimuli, it was

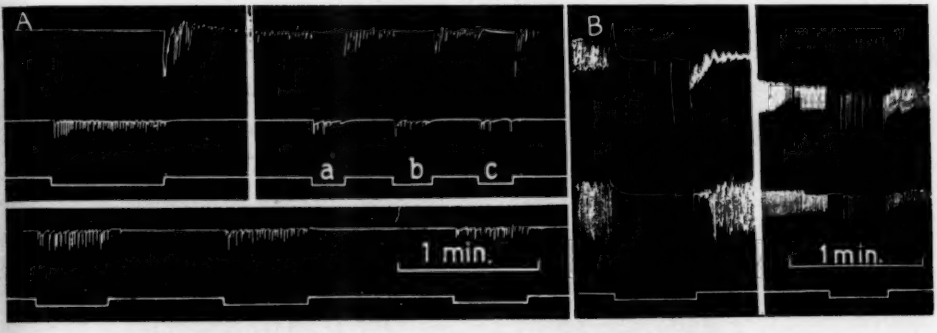

Fig. 8.—Effects of stimulation of the anterior lobe of the cerebellum in the cat after various strychnine doses (according to Moruzzi): *A*, subthreshold dose; *B*, threshold dose.

A, administration of subthreshold dose of strychnine. Note the quiet background. On faradization of the anterior lobe of the cerebellum, clonus of strychnine type was evoked in the extensor muscle; this shifted to the flexor muscle on withdrawal of the electrical stimulus. Isotonic recording of the tibialis anterior and the gastrocnemius-soleus complex is shown.

B, inhibition of strychnine convulsion by faradization of anterior lobe of the cerebellum convulsion. Isotonic myograms of the tibialis anterior and gastrocnemius-soleus complex. Note in the second strip that a weaker electrical stimulus produced only partial inhibition.

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33. Rossi, G.: Ricerche sulle eccitabilita della corteccia cerebrale in cani sottoposti ad emiestirpazione cerebellare, Arch. di fisiol. **10**:251-260, 1912.

34. (*a*) Snider, R. S.; Magoun, H. W., and McCulloch, W. S.: A Suppressor Cerebello-Bulbo-Reticular Pathway from Anterior Lobe and Parmedian Lobules, Federation Proc. **6**:207, 1947. (*b*) Snider, R. S., and Magoun, H. W.: Facilitation Produced by Cerebellar Stimulation, ibid. **7**:117-118, 1948. (*c*) Snider, R. S.; McCulloch, W. S., and Magoun, H. W.: A Cerebello-Bulbo-Reticular Pathway for Suppression, J. Neurophysiol. **12**:325-334, 1949. (*d*) Snider, R. S., and Magoun, H. W.: Facilitation Produced by Cerebellar Stimulation, ibid. **12**:335-345, 1949.

possible to map zones for the face (in the lobulus simplex), arm (in the culmen) and leg (in the lobulus centralis) within these areas. It was surprising to see that the localized areas of the cerebellum were identical with the tactile receiving areas. Nulsen and associates [35] were also able to get facilitation and suppression of cortically induced movement by stimulation of the anterior lobe and found localized

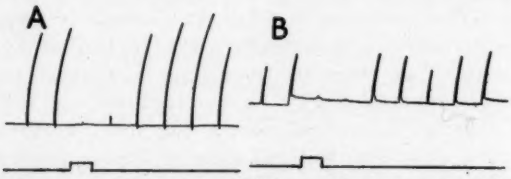

Fig. 9.—Effects of cerebellar stimulation on reflexively and cerebrally induced movement in the cat (pentobarbital sodium anesthesia).

A, effects of stimulation of the anterior lobe of the cerebellum on the patellar reflex. Similar effects can be obtained from stimulation of the paramedian lobule, although it is usually necessary to use higher voltage. The patellar reflex was elicited every five seconds.

B, effects of stimulation of the anterior lobe of the cerebellum on cerebrally induced movement (stimulation of the pericruciate area). Similar effects can be obtained from stimulation of the paramedian lobule. The suppressor area for the leg of the anterior lobe is in the lobulus centralis; that for the arm, in the culmen, and that for the face, in the lobulus simplex.

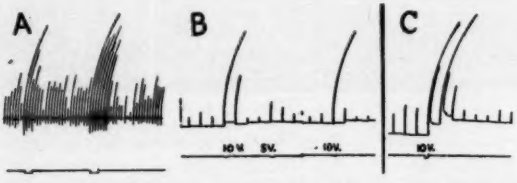

Fig. 10.—Facilitation of reflexively and cerebrally induced movement as a result of electrical stimulation of the cerebellum in the monkey (chloralosane anesthesia).

A, effects of cerebellar stimulation on the patellar reflex. The anterior lobe and paramedian lobule were stimulated at a rate of 200 pulses per second (falling phase 0.002 second). Note facilitated responses and poststimulatory effects when stronger stimuli were used. The patellar reflex was elicited every two seconds.

B, effects of cerebellar stimulation on motor activity (dorsiflexion of the wrist) induced by stimulation of the cerebral cortex (area 4) in the monkey. The cerebellar stimulus was applied to the ipsilateral (to movement) posterior folia of the anterior lobe. There are definite areas of facilitation for the leg, arm and face within the cerebellum.

C, similar to *B* except that the cerebellar stimulus was applied to the ipsilateral paramedian lobule.

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35. (*a*) Nims, G. F., and Nulsen, F. E.: Interaction of Cerebral Cortex and Cerebellum, Federation Proc. **6**:170, 1947. (*b*) Nulsen, F. E.; Black, S. P. W., and Drake, C. G.: Inhibition and Facilitation of Motor Activity by the Anterior Cerebellum. ibid. **7**:86-87, 1948.

areas identical with the ones previously described. These investigators also reported that the same point on the cerebellum, when properly stimulated gives either facilitation or inhibition of the cortically induced movement, the effect depending on the frequency of the stimulating current used. As shown in our experiments,[34c] the suppressor activity of the cerebellum is produced by stimulation of the bulbar suppressor centers of Magoun [36]; and, although the evidence is less conclusive, cerebellar facilitation probably takes place through the facilitatory centers of the brain stem. Thus, if the same cerebellar point can produce either facilitation or suppression, and acts through separate cerebellar nuclei, as Nulsen stated, two explanations are possible: (1) the acting Purkinje cells must have bifurcating axons, one branch of which goes to one nucleus and the other to a different nucleus, or (2) neighboring Purkinje cells must be sensitive to different frequencies of stimulating current. At present, sufficient data are not yet available to permit a decision as to which explanation is correct.

Hampson, Harrison and Woolsey [37] have studied these areas (lobus anterior–lobulus simplex and paramedian lobules) from another point of view. They studied overt movements in decerebrate animals which result from the electrical activation of these areas. It is interesting that they observed a somatotopic localization which was identical with that which Stowell and I [14] described for the tactile projection system, namely, a motor leg area in lobulus centralis, a motor arm area in the culmen, a face and neck area in lobulus simplex and a face, arm and leg area arranged craniocaudially in the paramedian lobule. An additional interesting observation was that extensor muscles were represented predominantly in a lateral position in the anterior lobe and the flexor muscles in a medial position, although there was considerable overlap between the two regions and results could be altered somewhat by increasing the strength of the stimulus. The latter point is emphasized because of a possible relation to the so-called cerebellar rebound. Hare, Magoun and Ranson [38] stimulated the cerebellar nuclei and observed during stimulation strong flexion of the ipsilateral limbs and the vertebral axis along with extension of the contralateral limbs. On withdrawal of the stimulus, there were contralateral flexion and ipsilateral extension of the extremities with contralateral concavity of the trunk. Since both facilitation and suppression can be obtained by stimulation

36. Magoun, H. W.: Bulbar Inhibition and Facilitation of Motor Activity, Science **100**:549-550, 1944.

37. Hampson, J. L.; Harrison, C. R., and Woolsey, C. N.: Somatotopic Localization in the Cerebellum, Federation Proc. **5**:41, 1946.

38. Hare, W. K.; Magoun, H. W., and Ranson, S. W.: Electrical Stimulation of the Interior of the Cerebellum in the Decerebrate Cat, Am. J. Physiol. **117**:261-266, 1936.

of the anterior lobe, and since these effects act through the tegmentum and the reticular formation of the brain stem, the following explanation of cerebellar rebound seems plausible. Closely spaced Purkinje cells of the anterior lobe, for example, exert their influence through the cerebellar nuclei, and the impulses pass thence to the facilitatory and suppressor centers of the brain stem, which, in turn, excite ipsilateral flexor muscles (and perhaps inhibit ipsilateral extensors) and contralateral extensors (and perhaps inhibit contralateral flexors). On withdrawal of the cerebellar stimulus, the Purkinje cells which were dominant during stimulation then become recessive, and nearby cells become dominant. This activity, in turn, passes to the center in the reticular formation and tegmentum, which has a function opposing that just outlined, and, instead of ipsilateral flexion, ipsilateral extension and contralateral flexion result. Nulsen, Black and Drake [35b] stated the belief that it is possible to separate these facilitatory and inhibitory effects of the cerebellum on the basis of the frequency of stimulation. However, regardless of the physiologic means of selectively activating the proper efferent tracts, it appears that one is much closer to the understanding of the mechanisms back of cerebellar rebound than ever before.

No discussion on cerebellar rebound is complete without mention of the excellent work of Clark and associates.[39] These investigators stimulated various parts of the cerebellar cortex in an extensive series of unanesthetized cats and divided the resulting effects into three phases: the phase of stimulus, the rebound and the long after-effect. The phases of stimulus and rebound are similar in most respects to those described by Hare, Magoun and Ranson, who stimulated the cerebellar nuclei in decerebrate animals. It is probable that these two phases of cerebellar activity act through the tegmentum and reticular formation. However, the long after-effect may be due to an entirely different mechanism, although one cannot categorically deny that it, too, may act through the same centers. Nevertheless, the fact that Hare, Magoun and Ranson did not see it in decerebrate animals and that Clark did not see it in animals in which a "trace" of anesthesia existed strongly suggest that higher centers, especially the cerebral cortex, may be involved.

That the cerebellum is connected with the cerebrum via the thalamus has long been known. Walker [40] noted that electrical activation of crus I and crus II increased the background electrical activity of the cerebral

39. Clark, S. L.: (*a*) Responses Following Electrical Stimulation of the Cerebellar Cortex in the Normal Cat, J. Neurophysiol. **2**:19-35, 1939; (*b*) Motor Seizures Accompanying Small Cerebellar Lesions in Cats, J. Comp. Neurol. **71**:41-57, 1939. Chambers, W. W., Jr.: Electrical Stimulation of the Interior of the Cerebellum in the Cat, Am. J. Anat. **80**:55-93, 1947.

40. Walker, A. E.: An Oscillographic Study of the Cerebello-Cerebral Relationships, J. Neurophysiol. **1**:16-23, 1938.

motor area. Moruzzi, as previously noted, showed that stimulation of the anterior lobe can suppress strychnine-induced (cerebral) movements or, if a subthreshold dose is administered, changes the subthreshold to a threshold effect.

The most extensive study of the various projection systems of the cerebellum onto the cerebrum has been made by Henneman, Cooke and Snider.[41] Figure 11 *A* shows that electrical stimulation of the paramedian lobule bilaterally and the lobus anterior–lobulus simplex area contralaterally evokes responses in the sensorimotor area of the cerebral cortex. The lobulus centralis projects to the cortical leg area, the culmen to the cortical arm area and the lobulus simplex to the cortical face area. There is a projection to somatic area II in the cerebral cortex, and in properly anesthetized preparations it is possible to differentiate projections from the lobulus centralis, the culmen and the

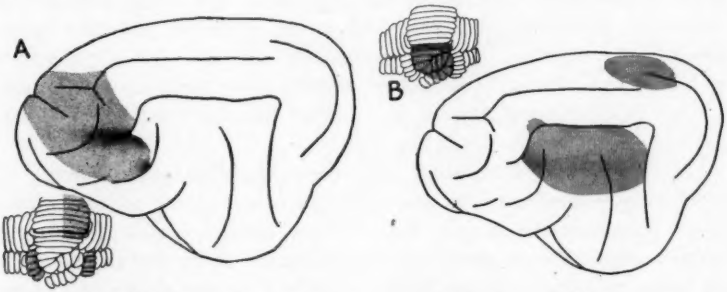

Fig. 11.—Projections of tactile, auditory and visual areas of the cerebellum to the cerebrum.

A, electrical stimulation of the tactile areas of the cerebellum, i. e., the contralateral anterior lobe–lobulus simplex area and the paramedian lobule bilaterally (see inset), produced responses within the pericruciate area of the cerebrum (stippled area). In general, if threshold stimuli were used, the leg region of the cerebellar areas projected to the leg regions of the cerebrum. Similar comments can be made for the arm and face areas. The cat was under chloralosane anesthesia.

B, electrical stimulation of the auditory and visual areas (audiovisual area) of the cerebellum (see inset) initiated responses within the auditory and visual areas of the cerebrum (vertical lines). The cat was under chloralosane anesthesia; threshold stimuli only were used.

lobulus simplex here also. The latent periods of these projections average about 6 milliseconds.

Figure 11 *B* shows that electrical activation of the lobulus simplex–tuber vermis area evokes responses in auditory areas I and II within the cerebrum. No attempt has been made to determine the pathway

41. (*a*) Henneman, E.; Cooke, P., and Snider, R. S.: Cerebellar Projections to the Cerebral Cortex in Cat and Monkey, Am. J. Physiol. **155**:443, 1948; (*b*) Cerebellar Projections to the Cerebrum, J. Neurophysiol., to be published.

or pathways involved, but the latency of the response ranges from 6 to 10 milliseconds. This region also includes the pinna (motor) area of the cerebrum.

Figure 11 *B* also shows that the lobulus simplex–tuber vermis (audiovisual) area also projects to the visual area of the cerebral cortex. No explanation is available as to why the posterior part of the cerebral visual area was not also activated. However, in occasional preparations a small responsive area was recorded at the lateralmost tip of sulcus lateralis, in addition to rather frequent responses occurring far forward, almost to sulcus ansatus in gyrus lateralis.

In summarizing this work [41b] on cerebellocerebral projections, it is necessary to refer to figures 6 and 7. It is especially important to note that the tactile, auditory and visual areas of the cerebellum have a dual projection—one from the end organ and another from similar areas within the cerebrum. It is also important to note that these same cerebellar areas project back on the tactile, auditory and visual areas of the cerebrum. Previously, the projection of the cerebellum onto the motor areas of the cerebrum has been recognized, but now that a projection to the various sensory (as well as motor) areas has been established, a much broader interpretation of cerebellar function must be used than has hitherto been the case in the past.

In addition to illustrating the cerebrocerebellocerebral circuit of functionally related areas, in which both the cerebrum and the cerebellum could potentiate the action of the other, figures 6 and 7 illustrate another point hitherto given scant consideration in the literature. Note the dual projection of the sensory systems to the cerebrum! One system passes through the thalamus to the cerebrum, and the other is by-passed by way of the cerebellum before going to the cerebrum. Since the cerebrum can act back on the cerebellar system, a self-regulating feed-back circuit is established, which could add to or substract from the total effect of the afferent volleys passing to the different functional areas. The report of Sjöqvist and Weinstein [42] added considerable weight to these statements. These workers found in chimpanzees with a trained proprioceptive skill, such as weight discrimination, that lesions of neither the medial lemniscus nor the superior cerebellar peduncle alone caused permanent loss of the trained skill. On the other hand, combined lesions of the two systems did produce permanent loss of the skill. If sufficiently sensitive tests could be developed, it is highly probable that similar results might be obtained for the tactile, auditory and visual systems.

42. Sjöqvist, O., and Weinstein, E. A.: Effects of Section of the Medial Lemniscus on Proprioceptive Functions in Chimpanzees and Monkeys, J. Neurophysiol. **5**:69-74, 1942.

The interrelation of the cerebellum and the cerebrum here described illustrates another principle concerning the cerebellum. As shown in figure 12, almost any major structure to which the cerebellum sends fibers also receives fibers from it, either directly or indirectly. In figure 12 *C* the cerebrum projects to the cerebellum via the pontile, and perhaps via the olivary, nuclei, while the cerebellum projects back to the cerebrum via the thalamic nuclei. This reverberating circuit is an outline of the one previously discussed. In figure 12 *A* are shown more involved recurrent circuits—i. e., the cerebrum to the basal ganglia to the reticular formation, and perhaps the inferior olivary nucleus,[43] and then through reticulocerebellar fibers to the cerebellum. The cerebellum can act back on the cerebral cortex through the thalamus; it can act back on the basal ganglia, also by way of the thalamus, or it can act

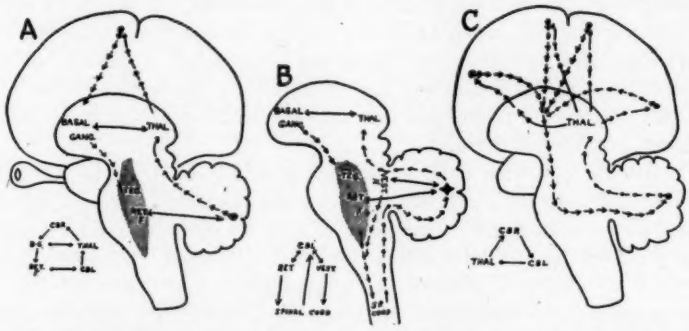

Fig. 12.—Schematic drawings illustrating the connections of the cerebellum with other major centers.

A, circuit from the cerebellum to the thalamus to the basal ganglia and/or the cerebrum, thence to the basal ganglia, back to the thalamus or down to the reticular formation and thence to the cerebellum. Note that the cerebellum can project back onto the reticular formation. (See figures 9 and 10 for one function of this projection.)

B, diagram showing that the cerebellum can exert its influence on the spinal cord via the vestibular nuclei or the reticular formation. The interrelations of these centers are also shown. The spinal cord can act back on the cerebellum through the spinocerebellar tracts.

C, one of the major recurrent circuits of the cerebellum, involving the cerebrum. Frontopontile, parietopontile, temporopontile and occipitopontile connections and pontocerebellar connections have long been known. (See figure 5 *D* for some of the known functional relations of cerebrum and cerebellum.) This diagram also shows that the cerebellum can project back on certain known functional areas of the cerebrum. (See figure 11 for more details.)

back on the reticular formation through the fastigiobulbar tract, which, as previously noted, can mediate a suppressor function. Thus, from this

43. Snider, R. S., and Barnard, J. W.: Electro-Anatomical Studies on the Afferent Projection to the Inferior Olive, J. Comp. Neurol. **91**:243 (Oct.) 1949. King, R. B.: The Olivo-Cerebellar System, ibid. **89**:207-223, 1948.

chart it can be seen that the cerebellum is part of an intricate system of reverberating circuits at a cerebral level, at a diencephalic level and at a medullary and mesencephalic level.

That the cerebellum is also part of an equally involved reverberating circuit or circuits acting at a spinal level is shown in figure 12 *B*. The cerebellum projects to vestibular nuclei (either directly from the cortex or from the central nuclei), and the vestibular nuclei can project back either onto the cerebellum, through the vestibulocerebellar fasciculus, or to the spinal cord, through the vestibulospinal tracts. The spinal cord, in turn, can act back on the cerebellum through the dorsal and ventral spinocerebellar tracts. Similar statements can be made about the reticular formation and the tegmentum. The cerebellum projects to the reticular formation (which can likewise act back on the cerebellum), then through the reticulospinal tracts to the spinal cord, then back through the spinocerebellar tracts to the cerebellum. It should be noted in passing that the dorsal and ventral spinocerebellar tracts are not the only pathways by which the spinal cord can exert its action on the cerebellum. If the spinotectal, the spino-olivary, the spinoreticular and a spinal projection to the external cuneate nuclei exist, all these nuclei project to the cerebellum.

Presentation of the data on efferent systems would not be complete without comment on cerebellar action on the autonomic nervous system. Many investigators agree that there is such an influence, and Fulton [44] has reviewed some of the earlier literature. Moruzzi [45] brought forth evidence to show that stimulation of the anterior lobe of the cerebellum can inhibit both vasopressor reflexes and respiratory carotid sinus reflexes. With the cerebellum acting within the vegetative, as well as the somatic, sphere, it is not necessary to point out the inadequacy of the earlier concepts of cerebellar function.

After this presentation of the efferent paths, it would be logical to present the results of study on dysfunctions in animals subsequent to various types of cerebellar ablations. Unfortunately, few such studies have been made recently. Such ablation studies, limited to known "functional" areas and carefully controlled histologically as a check on possible nuclear damage, are badly needed. Such experiments are further handicapped by the lack of sufficiently sensitive "clinical" tests and by the vast amount of physiologic "compensation" which apparently takes place after cerebellar lesions. Certainly, the last two factors were the cause of considerable anxiety to my colleagues and me during a large series of such, as yet unpublished, experiments.

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44. Fulton, J. F.: The Interrelation of Cerebrum and Cerebellum in the Regulation of Somatic and Autonomic Functions, Medicine **15**:247-306, 1936.

45. Moruzzi, G.: Paleocerebellar Inhibition of Vasomotor and Respiratory Carotid Sinus Reflexes, J. Neurophysiol. **3**:20-32, 1940.

By far the most extensive physiologic observations during the past few years have been made by Botterell and Fulton [46] and by Carrea and Mettler.[47] Both groups of investigators agree that the cerebellum exerts a profound influence on the coordination of somatic musculature. Walker and Botterell's [48] observations on monkeys after section of the superior cerebellar peduncle are also in agreement with this concept. No claims that autonomic and sensory disturbances result from cerebellar lesions have been made.

INTRINSIC ACTION OF CEREBELLAR CORTEX

After this summary of the afferent projections to the cerebellum and the efferent projections from it; the next question is: What does the cerebellum do to the afferent volleys before they become efferent volleys? Our own investigations are still in a preliminary state, and few other workers have studied this critical question. Dow [49] published a highly significant paper on the subject. He not only confirmed Adrian's [50] observation that the frequency of the electrical activity of the cerebellum is one of the highest within the entire nervous system (approximately 300 per second), but was also able to modify this activity by various pharmacologic and physiologic means. He noted, further, that section of "almost all efferent fibers to the cerebellum so long as the blood supply is not damaged modified the activity little, if any." That the fast activity is due to intrinsic rather than extrinsic, mechanisms has clearly been shown.[51] Eldred and I [51] observed the presence of rapid electrical activity in the cerebellum of chronic animals several days after transection of all afferent and efferent fibers. The question then arises: Is this electrical activity due to reverberating circuits or to the spontaneous "firing" of individual morphologic units? We [51] showed that the circuit from cortex to cerebellar nuclei back to cortex was not the responsible mechanism, since activity continues in the absence of the

46. Botterell, E. H., and Fulton, J. F.: Functional Localization in the Cerebellum of Primates: Unilateral Section of Peduncles, J. Comp. Neurol. **69**:31-87, 1938.

47. Carrea, R. M. E., and Mettler, F. A.: Physiologic Consequences Following Extensive Removals of the Cerebellar Cortex and Deep Cerebellar Nuclei and Effect of Secondary Cerebral Ablations in the Primate, J. Comp. Neurol. **87**:169-288, 1947.

48. Walker, A. E., and Botterell, E. H.: The Syndrome of the Superior Cerebellar Peduncle in the Monkey, Brain **60**:329-353, 1937.

49. Dow, R. S.: The Electrical Activity of the Cerebellum and Its Functional Significance, J. Physiol. **94**:67-86, 1938.

50. Adrian, E. D.: Discharge Frequencies in the Cerebral and Cerebellar Cortex, J. Physiol. **83**:32 P, 1934.

51. Snider, R. S., and Eldred, E.: On the Maintenance of Spontaneous Activity Within the Cerebellum, Am. J. Physiol. **155**:470, 1948.

nuclei. We concluded, further,[52] that this fast electrical activity was due to spontaneous discharges of the granule basket cell units and/or Purkinje cells.

Further advances in the subject was made by Moruzzi, Brookhart and Snider,[53] who by means of "microelectrodes" recorded the electrical activity of single units within the cerebellar cortex. It was easiest to record this activity from the granule and Purkinje cell layers. The molecular layer was remarkably quiet. Spike discharges of single units not being modified by "outside" influences ranged in frequency from 10 to 120 waves per second, a frequency of 60 waves per second being a common observation. Although discharges associated with injuries and strychnine bursts could introduce frequencies as high as 400 per second, the activity of a given unit without such modifying influences was seldom more than a fraction of this frequency, and never as fast as the spontaneous activity recorded by Adrian.[50] This interest-

Fig. 13.—Electrical activity of single units within the cortical granular layer of the anterior lobe of the cerebellum of the decerebrate cat. Recording was done by means of microwire electrode (12 microns diameter) insulated except at the tip. Activity of single units usually averaged between 30 and 60 per second. Background activity characteristic of the granule cell layer and not observed in the molecular layer is shown by heavy shading. At the beginning of stimulation (dorsiflexion of the second toe), there was increase of unit activity, which then slowed down and stopped but started with renewed activity at release of the stretch. After a short poststimulatory period, activity diminished but could be reintroduced by additional stimulation. During the period of very little unit activity there was good background activity.

ing discrepancy can be explained by some unknown form of synchronization existing among multiple units. Activity of the single units can be either facilitated or suppressed by such physiologic means as pinching the toe (fig. 13) and can be abolished by local application of procaine or by anoxia. It was not uncommon to see several units sporadically discharging at a uniform rate.

CEREBELLAR FUNCTION

For the cerebellum to function as an integral part of the nervous system, it is obvious that it must be well informed concerning the activity of related centers. Figures 6, 7 and 12 indicate that this is indeed the

52. Snider, R. S., and Eldred, E.: Maintenance of Spontaneous Activity Within the Cerebellum, Proc. Soc. Exper. Biol. & Med. **72**:124, 1949.

53. Moruzzi, G.; Brookhart, J. M., and Snider, R. S.: Activity of Single Units in the Cerebellar Cortex, Federation Proc. **8**:113, 1949. Brookhart, J. M.; Moruzzi, G., and Snider, R. S.: Activity of Single Units in the Cerebellar Cortex, J. Neurophysiol., to be published.

case, because not only sensory areas of the cerebrum, but also major motor centers at medullary, mesencephalic, diencephalic and cerebral levels, project there. As a matter of fact, in higher mammals the number of incoming fibers is more than double the number of outgoing ones (in man about 3:1). It is an interesting side light that in submammalian animals the ratio of afferent to efferent fibers is about 1:1. Afferent volleys to the cerebellar cortex spread extensively in a horizontal direction in the cortical layers. The anatomy of the cerebellar cortex is such as to allow for "maximal" horizontal spread. The arborizations of the Purkinje cell dendrites, the spread of the basket fibers and the bifurcations of the granule cell axons in a cortex which possesses foliations of immense elaborateness, not encountered anywhere else within the nervous system, emphasize this horizontal spread to a degree which makes one marvel. No doubt this functions to bring the afferent volleys into contact with as many granule cells and/or Purkinje cells as possible in order that these cells may modify the activity of the afferent volleys, or else be modified by them. The nature of this modification is not known, but work is in progress to elucidate the process.

After the afferent volley has passed through the cortex, a pooling effect must occur, since only about one half to one third as many fibers leave the organ as enter it (in higher mammals). Most of this step-down effect takes place at the level of the central cerebellar nuclei, the axons of which pass to extrinsic centers. No information on this synapse area is available, and only Jansen and Brodal [29] have made detailed corticonuclear projections. Nucleonuclear connections have not been studied, and Purkinje cell axons by-passing the central nuclei have been studied to a limited degree. All these points are of importance in an analysis of cerebellar function.

In a preliminary manner, the intrinsic action of the cerebellum and a few of the mechanisms used to handle different volleys have been considered. It is now necessary to introduce the broader question of the significance of the various afferent projection systems. Why are there tactile, auditory and visual areas within the cerebellum? Undoubtedly, these areas do not subserve any known conscious function. However, all investigators are agreed that lesions of this organ produce a disturbance of muscular coordination; and the possibility exists that an adequate photic stimulus, for example, a flash in the peripheral field of vision, would project its influence onto the visual areas of the cerebrum and cerebellum. If the latter functions in some manner to coordinate muscular movements as a result of a cerebral "decision," then the coordinator of the movement or group of movements is ready to exert its influence. The tuned response must, of course, act through spinal centers in order to function with proper temporal dispersion on the responsible muscles engaged in the motor act. The muscles, in turn,

can act back on the cerebellum by way of their afferent projections. These comments emphasize cerebellar action on motor centers and strongly indicate that the cerebellum can accentuate the action of one center while suppressing the action of another. Many reports in the literature support such a statement. For example, it has long been known that stimulation of the anterior lobe can suppress the extensor tone of decerebrate rigidity, and Walker's [40] work showed that electrical stimulation of crus I and crus II can increase the background activity of the cerebral motor areas. Moruzzi [32] demonstrated that stimulation of the anterior lobe can either facilitate or suppress cortically induced movements, the effect depending on whether the cerebral cortex is hypoactive or hyperactive at the time of action. These statements emphasize the role of the cerebellum in the coordination of motor activity (for other functions, see succeeding paragraphs) and emphasize the existence of intricate timing mechanisms between this organ and related centers.

So much for the action of the cerebellum within the motor sphere. The question now arises: What is its action within the sensory sphere?

That the cerebellum projects to various sensory areas of the cerebrum is adequately shown by figure 11 and by the work of Henneman, Cooke and Snider,[41b] but the action of the fast electrical activity of the cerebellum on these areas has not been worked out. It is probable that the action is similar to that exerted on motor areas. Workers in the field have been entirely too lethargic about recognizing this sensory action! Earlier evidence has been furnished by the work of Sjöqvist and Weinstein [42] and by Clark.[39a] The former investigators found that combined lesions of the superior cerebellar peduncle and the medial lemniscus produced permanent loss of a proprioceptive skill, while section of either one of these systems alone produced only temporary loss of the skill. Clark's [39a] studies were of an entirely different nature. He stimulated the cerebellum in unanesthetized animals, and in one protocol he reported the following:

> When it [the foot] reaches the floor it may be lifted quickly again and again as if the floor were too hot to rest upon. There is at times evidence of hypersensitivity to touch in the involved extremity, and it will withdraw suddenly on being stroked.

If this effect acts through the cerebral cortex, as seems possible, then it might be taken as evidence of increased activity of the somatic areas of the cerebrum.

If the cerebellum can act in both the sensory and the motor sphere, as is indicated, then many of the older concepts of cerebellar function must be greatly modified. For example, it becomes clear that the idea of cerebellar function as a whole must be withdrawn and the idea adopted that there are localized functional areas which may act interrelatedly. Another idea which must be discarded is that the cerebellum is an organ solely concerned with proprioception. Although one cannot deny the

passage of proprioceptive impluses to it, the term conveys the same distortion as would be implied by designating the cerebrum an organ of vision. Another idea of the older investigators which must be considerably broadened is that the cerebellum acts only to coordinate muscular activity. As has been seen, this concept is entirely too limited in its scope, and it is futile to argue whether the cerebellum is an "organ of tone" or an "organ of muscular synergy."

These newer contributions to knowledge of the cerebellum make it imperative that one adopt broader concepts of cerebellar function. Obviously, such functional concepts must encompass cerebellar influences on the sensory and motor centers of the cerebrum, as well as related influences on diencephalic, mesencephalic and medullary centers. As previously indicated, it is highly probable that this influence is exerted in such a way as to alter the threshold of excitability of these centers, depending on physiologic need. If, as seems likely, this action is exerted in a temporal sphere, either to potentiate or to dampen their activity, depending on their needs for proper function, then the cerebellum stands out as "the great modulator of neurologic function," and new horizons of cerebellar action are introduced into neurology and psychiatry.

SUMMARY

It is difficult to summarize a review which has been a "summary." Nevertheless, certain salient comments deserve particular consideration.

1. Tactile, auditory and visual areas are known to exist within the cerebellum.

2. Motor, tactile, auditory and visual areas in the cerebrum project to these same cerebellar areas, which, in turn, project back on the cerebral areas.

3. It has been established that almost every structure which projects to the cerebellum also receives a projection from it (seldom direct).

4. Certain areas of the cerebellum when properly stimulated produce localized movements and suppression or facilitation of cortically or reflexly induced movements.

5. Cerebellar stimulation can modify cerebral activity.

6. There are single neurologic units within the cerebellar cortex which are spontaneously active. It is believed that these units are Purkinje cells and/or the granule–basket cell complexes.

7. It is necessary to abandon the old concepts of a cerebellum which functions as a whole and functions entirely in a proprioceptive sphere.

8. A new concept of function is developed which includes cerebellar action in dampening and in potentiating associated sensory and motor centers alike. The cerebellum thus becomes the "great modulator of neurologic function."

FOCAL ELECTROENCEPHALOGRAPHIC CHANGES IN UNILATERAL ELECTRIC CONVULSION THERAPY

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THIS study was made to evaluate any unilateral or focal effects that might be the result of unilateral placement of stimulating electrodes in electric convulsion therapy. If the passage of the electric current is localized dependent on placement of the stimulating electrodes, it should be possible to demonstrate such localization by observation of the nature of the convulsion produced and by electroencephalographic recordings. Accordingly, extensive clinical, psychologic, electroencephalographic and neurologic studies have been made. This paper is concerned with the electroencephalographic findings in relation to the type of convulsion obtained and to the improvement manifested by the patient.

MATERIAL AND METHODS

The choice of patients for the entire study considered only the patient's ability to cooperate adequately for electroencephalograms and psychologic evaluation. All subjects were men, mostly between the ages of 20 and 30, the commonest diagnosis being paranoid schizophrenia. Patients with other classifications of schizophrenia, as well as manic-depressive psychosis, were also included. Otherwise, the series comprised the usual heterogeneous group of psychotic patients proposed routinely for electric convulsion therapy by the staff of this hospital.

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The Offner electric shock apparatus type 732 was used exclusively for administration of the convulsion. The four and six channel Grass electroencephalograph instruments were used for the recordings.

The patients were divided into three groups. The first group consisted of 23 patients who were used as controls. They received the standard electric convulsion therapy, in which the bitemporal placement of electrodes (4.7 by 3.7 cm.) was employed. The minimal dose adequate to produce a grand mal convulsion was administered. Induction of petit mal seizures was avoided. The patients received treatment three times a week until a total of sixteen treatments had been given.

TABLE 1.—*Diffuse Electroencephalographic Changes Occurring During a Course of Sixteen Electric Convulsion Treatments in Which Bitemporal Placement of Electrodes Was Employed (Control Series)*

	Electroencephalographic Changes							
	Focal		Diffuse			Clinical Improvement		
Case Number	Right	Left	Slow	Fast	None	Great	Slight	None
1	..	..	+	..	..	+	..	..
2	..	..	..	..	+	..	+	..
3	..	..	+	..	..	..	..	+
4	..	..	..	+	..	..	..	+
5	..	..	..	..	+	..	+	..
6	..	..	+	..	..	..	+	..
7	..	..	+	..	..	..	..	+
8	..	..	+	..	..	+	..	..
9	..	..	+	..	..	..	..	+
10	..	..	..	..	+	..	..	+
11	..	..	+	..	..	..	+	..
12	..	..	+	..	..	+	..	..
13	..	..	+	..	..	+	..	..
14	..	..	+	..	..	..	..	+
15	..	..	+	..	..	+	..	..
16	..	..	+	..	..	..	..	+
17	..	..	+	..	..	..	+	..
18	..	..	+	..	..	+	..	..
19	..	..	..	..	+	+	..	..
20	..	..	..	..	+	..	..	+
21	..	..	+	..	..	..	..	+
22	..	..	+	..	..	..	..	+
23	..	..	+	..	..	..	+	..

Observations during the convulsion included any unilateral effects, such as deviation of eyes, deflection of the head either to the right or to the left and extension of one side of the body with flexion of the other side. The reactions recorded were the first sustained unilateral movements occurring after application of the current, and they usually took place during the tonic phase of the convulsion.

Electroencephalographic studies were made prior to and two weeks after therapy was terminated. The results are summarized in table 1. In this group no focal electroencephalographic abnormalities were observed. Seventeen of the 23 patients (74 per cent) showed the usual diffuse slowing of activity. One patient had a record of fast activity and 5 patients failed to show any change after electric convulsion therapy. In considering this control series, it is to be observed that records were obtained on only two occasions, before and two weeks after treatment.

The second group, comprising 17 patients, was a preliminary series in which twenty-three combinations of electrode placements were tested. Examples of such

positions were vertex–right frontal, vertex–left frontal, vertex–right temporal, vertex–left temporal; bifrontal, biparietal, bioccipital and fronto-occipital; left frontal–right occipital, right frontal–left occipital; left frontal–left occipital, right frontal–right occipital. Electrodes of graded sizes from the standard 4.7 by 3.7 cm. to 1 cm. in diameter were utilized. Each position was tried three or four times with the same patient, who received about sixteen treatments in four or five different positions. With each position, at least one electroencephalographic tracing was made concomitantly with the treatment (before, during and after treatment until recovery). The unilateral characteristics of the convulsion were recorded as in the control group. No difficulties, such as respiratory or cardiac complication, were encountered. The results for this group will be described in another publication.

TABLE 2.—*Focal Electroencephalographic Changes Occurring During a Course of Sixteen Electric Convulsion Treatments in Which Unilateral (Right Temporal–Right Occipital) Placement of Electrodes Was Employed*

	Electroencephalographic Changes					Clinical Improvement		
	Focal		Diffuse					
Case Number	Right *	Left	Slow	Fast	None	Great	Slight	None
24	S_2 frontal	..	..	..	..	+	..	..
25	S_2 frontal-temporal	..	..	..	..	..	+	..
26	S_2 frontal-temporal	..	..	..	..	+	..	..
27	S_2 frontal-temporal-parietal	..	..	..	..	..	+	..
28	*	..	+	..	..	..	+	..
29	.....	..	..	..	+	+	..	..

* S_2 electroencephalographic activity is defined as bursts of smooth slow activity of a frequency of 4 to 6 per second; S_3 activity, as large irregular slow activity of a frequency of 1 to 4 per second.

From this study, it was decided that the most likely placement for the production of unilateral effects would be the right temporal–right occipital area or the left temporal–left occipital area.

Accordingly, a third group of 14 patients, similar in all respects to the control series, was observed. With 8 patients the left temporal–left occipital position was employed; with the remaining 6 patients the right temporal–right occipital position was used. Small electrodes, 1 cm. in diameter, placed approximately 12 cm. apart, were employed. Electroencephalographic studies were conducted prior to treatment and, in most instances, on the first and third days after administration of the fourth, eighth, twelfth and sixteenth electric convulsions, respectively. A two week record and, in some cases when necessary, a six week follow-up record were obtained. A total of 111 records for the 14 patients, an average of 8 records per patient, were obtained. In all other respects, the treatment and the observations were conducted in the same manner as in the control group.

RESULTS

Right Temporal–Right Occipital Stimulation (6 Cases).—Table 2 presents the electroencephalographic results correlated with the clinical improvement of the patient. Four of the 6 patients presented a slow

wave focus in the right frontal area. The right temporal area was also involved in 3 of the patients showing focal slowing. One of the 6 patients presented the usual diffuse slowing (similar to the controls), and 1 showed no change in cerebral activity as recorded in the electroencephalogram. For 4 of the 6 patients two week follow-up electroencephalograms were taken and all records were found to have returned to a condition similar to the pretreatment record.

In this group there was a tendency toward a unilateral clinical result, shown in table 4. This reaction was characterized by a deflection of the head to the left and extension of the body to the left, with flexion of the left arm and extension of the right arm. There was also deviation of the

TABLE 3.—*Focal Electroencephalographic Changes Occurring During a Course of Sixteen Electric Convulsion Treatments in Which Unilateral (Left Temporal–Left Occipital) Placement of Electrodes Was Employed*

	Electroencephalographic Changes					Clinical Improvement		
	Focal*		Diffuse					
Case Number	Right	Left	Slow	Fast	None	Great	Slight	None
30	S_2 frontal-temporal	.....	..	..	..	+	..	..
31	S_2 frontal-temporal	.....	..	..	..	+	..	..
32	S_2 frontal-temporal-parietal	.....	..	..	..	..	..	+
33	.....	S_2 temporal bifrontal	..	..	..	..	+	..
34	.....	S_2 temporal	..	..	..	..	+	..
35	.....	S_2 temporal	..	..	..	+	..	..
36	.....	.....	+	..	..	..	+	..
37†	.....	.....	+	..	..	..	+	..

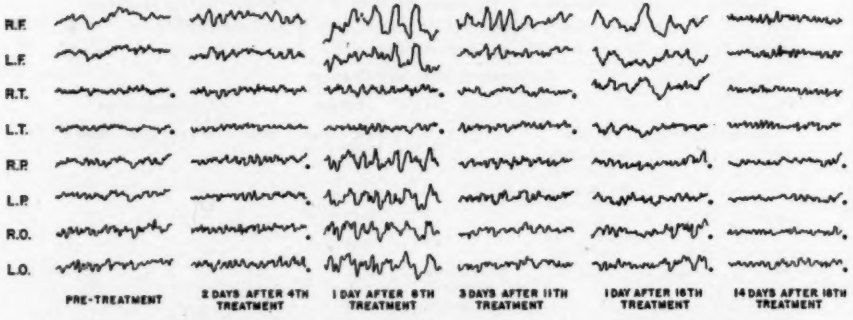
S_2 activity is defined as bursts of smooth slow activity of a frequency of 4 to 6 per second; S_3 activity, as large irregular slow activity of a frequency of 1 to 4 per second.
† See text.

eyes to the right. The deviation of the eyes could be a reflex action to turning the head to the left. It seemed that the aforedescribed reactions occurred oftener when the dose of current closely approximated the threshold for production of a grand mal convulsion. The left-sided flexion and the right-sided extension of the arms would be expected when direct stimulation to the right motor cortex areas was applied. Neurologic examination made two weeks after termination of treatment failed to show any significant changes in this group.

Left Temporal–Left Occipital Stimulation (8 Cases).—Table 3 presents the results for this group. Six of the 8 patients manifested a slow wave focus, which was in the right frontal–right temporal area in 3 subjects and in the left temporal area in 3 others. The remaining 2 patients of this series showed diffuse slow activity. Note is made of the results for patient 37, which were charted as slow diffuse activity. The

records showed no consistent focus, but various areas showed a focus at various times. However, the record three days after the sixteenth treatment showed focal bursts in the right frontal, right temporal and left occipital areas. It is interesting to speculate that with more treatments this patient might also have shown a predominant right-sided focus. Three of these 8 patients showed a return to the pretreatment record within two weeks after treatment. Twelve patients for whom follow-up records were obtained all showed return to the pretreatment record within six weeks after completion of treatment.

In this group, the convulsions obtained (table 4) were less characterized by unilateral movements than were the convulsions for which right-sided stimulation was used. However, a tendency to the opposite



Development of electroencephalographic focal activity in the right frontal–right temporal area as a result of unilateral stimulation (left temporal–left occipital electrode placement) in electric convulsion therapy.

The black circles indicate activity simultaneous with activity in the leads designated, but not simultaneous with activity in other leads.

TABLE 4.—*Clinical Characteristics of the Convulsion When Different Positions of the Stimulating Electrodes Were Used in Electric Convulsion Therapy*

Position of Stimulating Electrodes	No.	Deviation						Flexion of Right Arm Extension of Left Arm	Flexion of Left Arm Extension of Right Arm
		Eyes		Head		Body			
		Right	Left	Right	Left	Right	Left		
Bilateral (control).....	368	57 15%	47 13%	5 2%	28 8%	0 0%	13 4%	9 3%	1 0.5%
Right side.....	81	21 26%	12 15%	0 0%	26 32%	0 0%	19 23%	3 4%	17 21%
Left side.....	110	7 6%	13 12%	20 18%	7 6%	9 8%	1 1%	9 8%	4 4%

reaction of deflection of the head to the right and the body to the right and flexion of the right arm with extension of the left arm was observed.

Again, the eyes deviated in the direction opposite that of the head. Neurologic examination of this group two weeks after treatment also failed to demonstrate any significant signs.

COMMENT

In a review of the literature specifically related to this work, it is noted that Pacella, Barrera and Kalinowsky [1] reported the development of 3 to 6 cycles per second waves of moderate to high voltage with successive electric convulsion treatments. They reported that the abnormality was first noted as frontal slowing, synchronous on the two sides, occurring after the third to the fifth generalized convulsion. The slowing spread to other areas of the brain. The authors related the persistence of the disturbance to the number of treatments given, stating that of patients receiving thirteen to sixteen convulsions the electroencephalographic disturbance persisted two to six months in 70 per cent and longer than six months in 30 per cent. They stated that there appeared to be no relation between the clinical improvement per se and the electroencephalographic pattern. It is to be noted that these authors employed only the bilateral method of stimulation, which we have described as the standard method in use in our control group. Levy, Serota and Grinker [2] reported that approximately 50 per cent of their patients showing electroencephalographic disturbances of slowing bicuspid and dicrotic waves, spike and wave formations and greatly increased amplitude continued to show the disturbance up to six months after treatment. Hoagland, Malamud, Kaufman and Pincus [3] stated that they found no correlation between the efficacy of the treatments and the gross and dramatic shifting of waves in the electroencephalogram from a 10 per second frequency to that of 4 or 5 per second with an amplitude of 100 or more microvolts, or recovery therefrom in subsequent weeks.

The clinical results with respect to effect of treatment on the psychosis are indicated in tables 1, 2 and 3. There did not seem to be any definite correlation between development or site of a focus and the clinical improvement. On comparison of the 14 patients receiving unilateral stimulation with the 23 patients receiving the standard method of stimulation, there seemed to be a higher incidence of improvement

1. Pacella, B. L.; Barrera, S. E., and Kalinowsky, L.: Variations in the Electroencephalogram Associated with Electric Shock Therapy of Patients with Mental Disorders, Arch. Neurol. & Psychiat. **47**:367-384 (March) 1942.

2. Levy, N. A.; Serota, H. M., and Grinker, R. R.: Disturbances in Brain Function Following Convulsive Shock Therapy: Electroencephalographic and Clinical Studies, Arch. Neurol. & Psychiat. **47**:1009-1029 (June) 1942.

3. Hoagland, H.; Malamud, W.; Kaufman, I. C., and Pincus, G.: Changes in the Electroencephalogram and the Excretion of 17-Ketosteroids Accompanying Electroshock Therapy of Agitated Depression, Psychosom. Med. **8**:246-251 (July-Aug.) 1946.

in the group with unilateral stimulation; particularly right-sided stimulation. In this evaluation, 14 patients did not constitute large enough a series to permit any statistical conclusions. We do not wish at this time to advocate the preferability of unilateral stimulation over the standard bitemporal method now in use in most hospitals, although no deleterious effects have been observed with the former method.

For the 14 patients receiving unilateral stimulation in electric convulsion therapy, the outstanding finding was the development of a slow wave focus. This slow wave focus was most commonly found in the right frontal area regardless of the side of stimulation (7 out of 14 cases). Next in vulnerability were the right and left temporal areas, with evidence of spread to the bifrontal and parietal areas. The occipital poles showed the least vulnerability, with only 3 of the 111 records showing any evidence of disturbance.

SUMMARY AND CONCLUSIONS

A group of 14 psychotic patients were subjected to electric convulsion therapy in which a new technic of unilateral electrode placement was employed. Detailed clinical and electroencephalographic observations were made throughout the course of sixteen treatments, with follow-up examinations.

Focal electroencephalographic changes were produced by unilateral placement of stimulating electrodes in electric convulsion therapy.

Vulnerability of the right frontal area for slow wave activity regardless of electrode placement was demonstrated.

The occipital area showed the least vulnerability for focal activity.

Recovery from effects of electric convulsion therapy as recorded by electroencephalogram was faster with unilateral stimulation than with the standard bilateral method of stimulation.

No characteristic convulsive reaction was obtained by unilateral stimulation, but a tendency toward flexion on the left side and extension on the right side was noted when right-sided stimulation was employed. The opposite reaction was less characteristic of left-sided stimulation.

No untoward or complicating clinical, neurologic or electroencephalographic effect was observed with the unilateral method of electric convulsion therapy that was not also seen with the standard bitemporal method.

The Veterans Administration cooperated in this study, and Miss Dorothy Becka scheduled the patients and had charge of the electroencephalographic laboratory.

TREATMENT OF TUMORS OF THE PINEAL BODY

Experience in a Series of Twenty-Two Cases

GILBERT HORRAX, M.D.
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FROM THE earliest days of operations for tumors of the brain up to the past twenty years, all attempts to extirpate solid growths which had apparently arisen from the pineal body (pinealomas, teratomas or gliomas) resulted in immediate operative fatality or the patient, if he chanced to survive the operation, died of a recurrence or of some other cause within a few months or, at most, a year or two. These early experiences were important, however, in demonstrating at least that it was possible to approach the pineal region by one or another operative procedure. In particular, the method devised by Brunner (cited by Rorschach [1]), and later modified and used by Dandy,[2] has been the procedure of choice for operations on pineal tumors by most neurosurgeons. That any operation designed for the removal of a pineal tumor is an extremely hazardous undertaking is well known to all neurosurgeons, even in the present era, when all modern adjuncts can be utilized. Cushing [3] made the statement in 1932 that he had "never succeeded in exposing a pineal tumor sufficiently well to justify an attempt to remove it." Dandy [4] in 1936, in reviewing his experiences with 10 cases of pineal tumor, reported 7 consecutive deaths during the period from 1921 to 1931 and stated that this "seemed almost to indicate the futility of further efforts." In 1 of the subsequent 3 cases which he reported in this paper [4] death occurred from recurrence of the tumor two and a half years later; in a second case death occurred three months after operation, and in the third the patient was well at the time of the report, but this was only four months after operation. Other individual reports of partial

From the Department of Neurosurgery, the Lahey Clinic, New England Deaconess Hospital and New England Baptist Hospital.

1. Rorschach, H.: Zur Pathologie und Operabilität der Tumoren der Zirbeldrüse, Beitr. z. klin. Chir. **83**:451, 1913.

2. Dandy, W. E.: An Operation for the Removal of Pineal Tumors, Surg., Gynec. & Obst. **33**:113, 1921.

3. Cushing, H.: Intracranial Tumors: Notes upon a Series of Two Thousand Verified Cases with Surgical Mortality Pertaining Thereto, Springfield, Ill., Charles C Thomas, Publisher, 1932, p. 64.

4. Dandy, W. E.: Operative Experiences in Cases of Pineal Tumor, Arch. Surg. **33**:19 (July) 1936.

removal of tumors of the pineal body are those of Foerster,[5] Van Wagenen,[6] Harris and Cairns [7] and Horrax,[8] with survival periods up to fifteen months.

In 1943 Russell and Sachs [9] collected from the literature 58 cases of what they considered true pinealomas. In 32 of these cases operation had been performed for removal of the tumors, and in all but 3 cases the patients were known to be dead. Two of the living patients had only recently left the hospital at the time of the report, and the third patient was that of Harris and Cairns. This patient had shown signs of recurrence nine months after operation, but his condition had improved after roentgen treatment.[10]

In all probability, the first true pinealoma to be completely removed was that of a patient who was operated on by Peet in 1929 and reported by Kahn [11] in 1937. At the time of the report, seven years after operation, the patient was living and well. He had been given high voltage roentgen radiation for a year after operation. In the same article Kahn also reported the case of a teratoma of the pineal region which he himself had removed, with the patient alive and well one year later. This patient survived ten years and died of a heart attack. He had been relatively well and had engaged in work (personal communication from Dr. Kahn). Another important case which has heretofore been overlooked in the literature is that described by Pratt and Brooks [12] in 1938. In this instance a solid tumor, measuring 3.5 by 3 by 2 cm., was apparently completely removed from the pineal region. The histologic description leaves little doubt that it was a true pinealoma. The patient received

5. Foerster, O.: Das operative Vorgehen bei Tumoren der Vierhügelgegend, Wien. klin. Wchnschr. **41**:986, 1928.

6. Van Wagenen, W. P.: A Surgical Approach for the Removal of Certain Pineal Tumors, Surg., Gynec. & Obst. **53**:216 (Aug.) 1931.

7. Harris, W., and Cairns, H.: Diagnosis and Treatment of Pineal Tumors, Lancet **1**:3, 1932.

8. Horrax, G.: Extirpation of a Huge Pinealoma from a Patient with Pubertas Praecox: A New Operative Approach, Arch. Neurol. & Psychiat. **37**:385 (Feb.) 1937.

9. Russell, W. O., and Sachs, E.: Pinealoma: A Clinicopathologic Study of 7 Cases with a Review of the Literature, Arch. Path. **35**:869 (April) 1943.

10. This patient survived two years and seven months, and, although roentgen treatment apparently helped him for a while, he eventually died of a recurrence (personal communication from Dr. Cairns).

11. Kahn, E.: Surgical Treatment of Pineal Tumor, Arch. Neurol. & Psychiat. **38**:833 (Oct.) 1937.

12. Pratt, D. W., and Brooks, E. F.: Successful Excision of a Tumour of the Pineal Gland, Canad. M. A. J. **39**:240, 1938.

no roentgen therapy and was alive and well three and one-half years after operation.[13]

At a meeting of the Radiological Society of North America in December 1947, I summarized briefly my own experiences with pineal tumors, and this paper was published in February 1949.[14] In the present communication, an elaboration of that report, a more detailed account is given of several of the cases in which treatment was by radical removal of the tumor or a simple decompression followed by roentgen therapy.

The diagnosis of a pineal tumor was made in 22 cases occurring in my service at the Lahey Clinic between 1932 and 1948. Histologic verification of the tumor at operation or at necropsy was made in 13 cases. In most of the remaining 9 cases increased intracranial pressure and neurologic evidence of a pineal tumor were present, and in all the diagnosis was established beyond reasonable doubt by ventriculograms, which showed a sharply defined, rounded projection producing a filling defect in the posterior portion of the third ventricle.

HISTOLOGICALLY VERIFIED PINEAL TUMORS

In 10 of the 13 cases in which the tumor was verified histologically, a radical removal of the tumor was carried out, and in 3 the verification was made either by biopsy at operation or by necropsy. In 5 of the 10 cases in which the tumor was radically removed death occurred within a few days to three months after the operation. In 1 case the patient lived eight years after a primary incomplete removal of the tumor followed by high voltage roentgen therapy but died a few days after radical extirpation of the tumor. There were 2 cases of "ectopic" pinealomas in the chiasmal region. In 1 of these the patient was alive and well at the time of this report, seven and one-half years after removal of his tumor; but the case is not considered here, since he has never had evidence of a tumor in the pineal region. In the other case of an ectopic tumor the primary pineal tumor was removed by Dr. John Scarff, in New York, and the patient lived four years after removal of the tumor combined with high voltage roentgen therapy. He died a few months after the excision of his chiasmal tumor, in spite of further roentgen irradiation of this area. An encephalogram at this time showed no evidence of any remaining tumor in the pineal region.

The 3 patients whose tumors were verified either by necropsy or by biopsy all died after operation. In the remaining 2 cases in which

13. This patient was living and well until June 1946 (twelve years after operation) and had given birth to six children during this time. She died in March 1948 (fourteen years after operation) without evidence of recurrence of the tumor (personal communication from Dr. Pratt).

14. Horrax, G.: The Diagnosis and Treatment of Pineal Tumors, Radiology **52**:186, 1949.

the pineal tumors were apparently completely removed the patients are in excellent health and have been usefully employed twelve and five and one-half years, respectively. Brief summaries of these 2 cases follow. Case 1 represents the longest survival period so far recorded after radical, and apparently complete, removal of a pinealoma.

CASE 1.—B. P., an unmarried white woman aged 35, was referred by Dr. J. J. Skirball, of Boston, and was admitted to the New England Deaconess Hospital on Oct. 22, 1937. She had had severe frontal headaches for three months, and had complained of dizziness and double vision for ten days prior to admission. Neurologic examination disclosed 4 to 5 D. of papilledema, nonpersistent upward and lateral nystagmus and generally overactive reflexes. Her pupils reacted normally, and the other ocular movements were normal.

On October 27 ventriculographic examination showed that the ventricles were greatly dilated (120 cc. of fluid was removed), and subsequent roentgenograms

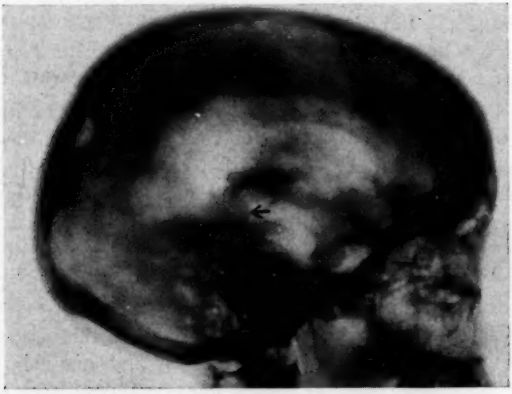

Fig. 1 (case 1).—Lateral ventriculogram, showing pronounced dilatation of the lateral ventricles and the rounded projection (arrow) in the posterior portion of the third ventricle.

showed a sharply defined, rounded projection into the posterior portion of the third ventricle (fig. 1).

Operation.—Immediately after the ventriculographic procedure an osteoplastic flap was turned down in the parieto-occipital region, and the right occipital pole was resected. The splenium of the corpus callosum was then incised, and beneath it there presented a tumor which spread the internal cerebral veins (lesser veins of Galen) apart. The posterior portion of the falx was resected back to the tentorium to attain better exposure of the tumor.

An attempt was first made to remove the growth intact, but this was not feasible. Its capsule was therefore incised, and the contents were removed by spoons and suction. The capsule was then withdrawn from the surrounding structures, leaving a smooth surface along its bed on the corpora quadrigemina. The tumor was soft and highly vascular, but removal was apparently complete.

The patient's convalescence was stormy. Ventricular taps were made twice daily and sometimes oftener. Eight days after operation the bone flap was reelevated because a postoperative clot was suspected, but none was found.

Progress Notes.—November 9: The patient was conscious and rational, but concentration and memory were poor. Her pupils were dilated and reacted poorly to light and not at all in accommodation. There was paralysis of the left abducens nerve. Conjugate movements of the eyeballs were good toward the right and downward, but the eyeballs could not be elevated above the horizontal plane, nor could they be turned to the left beyond the median line (fig. 2). Convergence was nil. There were complete left homonymous hemianopsia and left partial hemiplegia, the latter showing improvement, although it had been complete immediately after operation. The elevation of the optic disks had subsided to between 2 and 3 D.

Fig. 2 (case 1).—Conjugate deviation of the eyes to the right and somewhat downward, which was present for several weeks after operation.

Jan. 26, 1938: The patient was discharged on this date, having made excellent general progress since the time of the previous notation. She had been up and about the ward for two or three weeks but was not yet fully oriented, with some difficulty in memory for recent events only. Her pupils were moderately dilated and reacted well in accommodation and fairly well to light. All extraocular movements, including upward gaze, were now completely normal. The optic disks showed no elevation. There were astereognosis of the left hand and moderate weakness of the left arm and leg, but no loss of sensation to pain or temperature stimuli. The left homonymous hemianopsia, of course, remained complete.

April 4 to 9, inclusive: In this period she was given a series of high voltage roentgen treatments.

Oct. 26, 1938: She had begun part time in usual work as a stenographer on May 15, 1938, and at the present date, one year after operation, she was doing

full time work, being able to take dictation and do her typing with both hands without difficulty. She had become accustomed to the left homonymous hemianopsia.

Last Report (June 22, 1949): During the postoperative period, of eleven years and eight months, she had remained in excellent general health and had been at

Fig. 3 (case 1).—Photomicrograph of tumor (× 244) showing the general character and uniformity of the undifferentiated cells. Note the closely packed rows, with a tendency to mosaic pattern. Hematoxylin and eosin stain.

her regular work as a secretary. Her fundi and ocular movements were normal. Both pupils reacted to light, but the left very faintly. The reaction in accommodation was normal. The left homonymous hemianopsia was complete, as before.

Pathologic Report.—The tumor was moderately cellular and fairly uniform. It was composed of epithelium-like cells, resembling parenchyma cells of the pineal body. These were usually arranged in closely packed rows along strands of delicate vascular stroma (fig. 3). The cytoplasm of the cells was relatively

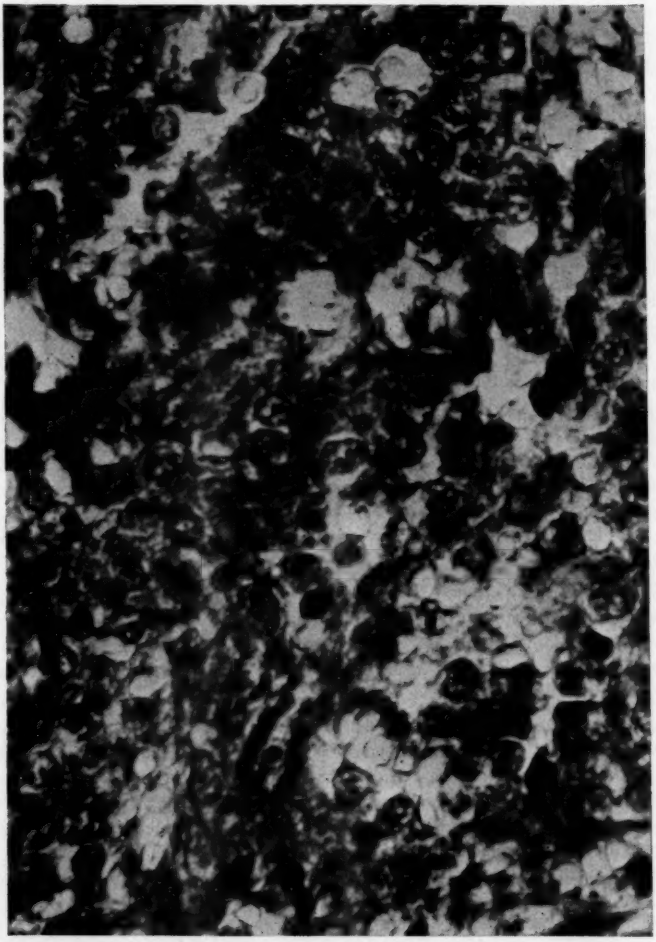

Fig. 4 (case 1).—High power photomicrograph of the tumor (× 815) showing more distinctly the large epithelium-like cells with their round vesicular nuclei. None of the small, lymphocyte-like cells appear in this field. Hematoxylin and eosin stain.

scant and showed no well defined glial process. The nuclei were round or oval and vesicular with indistinct nucleoli (fig. 4). Mitotic figures were rare. Small lymphocyte-like cells were present but infrequent. The histologic diagnosis was pinealoma.

Comment.—The feature of greatest neurological interest in this case was the absence before operation of the ocular phenomena which are characteristic of tumors in this locality; this is the more significant since the tumor was large, probably at least 30 to 35 Gm. in weight, although this could only be estimated, the greater portion of the growth having been lost through suction. The tumor, however, was soft and thus may not have exerted much pressure on the brain stem. It is of interest, also, that the patient rapidly became used to the complete left homonymous hemianopsia and was able to resume her secretarial work about seven months after her serious operation.

Now, after twelve years, it can almost certainly be assumed that she is permanently cured. Her case can thus be classed with that of the patient operated on by Peet and reported by Kahn as being well seven years after operation, and the case of Pratt and Brooks, in which no evidence of recurrence was present after fourteen years.[13]

CASE 2.—M. J. K., an unmarried school teacher aged 25, was referred by Dr. C. S. Andrews, of Boston, and was admitted to the New England Deaconess Hospital on Jan. 25, 1944.

History.—Her menstrual periods began at the age of 13 years and occurred regularly at six week intervals until September 1942, when they became irregular, with intervals up to two months. Her last period had been on Aug. 18, 1943, five months before her admission. Since November 1943 she had had four episodes of severe headache and vomiting, each episode lasting about twenty-four hours. She had also become increasingly unsteady in walking during this period. Some difficulty in vision had been noted during the month prior to admission.

Neurologic Examination.—Her pupils were equal and reacted normally, and all extraocular movements were normal, including upward gaze. Her fundi showed bilateral choked disks with an elevation of 4 to 5 D. She had an unsustained nystagmus, hypotonia of her right arm and a strongly positive Romberg sign. Her gait was ataxic with a tendency to fall to the right.

Operation (Jan. 27, 1944).—A ventriculogram, made on this date, showed a dilated ventricular system, with a questionable filling defect in the posterior portion of the third ventricle (fig. 5). Since the ventriculogram was thought to be inconclusive and the cerebellar symptoms were outspoken, a cerebellar exploration was carried out, but no tumor was disclosed. A catheter inserted upward through the fourth ventricle met with obstruction at a distance of 4 cm.

The cerebellar wound was closed, and immediately afterward an osteoplastic flap was turned down in the right occipitoparietal area. After removal of the right occipital lobe, the tentorium was incised down to the incisura and the falx incised a short distance upward. The splenium of the corpus callosum was divided and the tumor exposed in the posterior end of the third ventricle. The growth was grayish brown and had a fairly firm capsule. The right internal cerebral vein was divided to gain better exposure, after which the capsule of the tumor was incised and its contents were removed by spoons and suction. The remaining capsule and tumor fragments were then excised. Closure was carried out with drainage to the tumor cavity.

Convalescence was stormy. On February 2 the bone flap was reelevated, since the patient had become drowsy; but no clot was found. On February 8 a catheter was inserted into the left lateral ventricle for purposes of decompression and left in for forty-eight hours. On February 15 a decompression was carried out in the right subtemporal region and a catheter left in the right lateral ventricle for forty-eight hours. After the last procedure she made a satisfactory, but very gradual, convalescence.

Roentgen Therapy.—Between February 18 and March 6 she was given a series of high voltage roentgen treatments, a total of 2,100 r being delivered through each of two ports to the pineal region.

Subsequent Course.—She was discharged to her home on April 5, and at that time she was alert, talking, eating well and moving both arms and both legs well.

Fig. 5 (case 2).—Lateral ventriculogram showing extreme dilatation of the lateral ventricles, as well as lack of filling in the posterior portion of the dilated third ventricle due to rounded projection of tumor (arrows).

May 9, 1944: On this date she was sitting up and walking a little. She was clear mentally. There was slight weakness of the left arm and leg.

Oct. 1, 1945: On this date, one year and eight months after operation, her condition was practically normal except for the left homonymous hemianopsia. There was no weakness or sensory deficit on the left side. She was normally active physically and had resumed her teaching to a limited extent.

July 19, 1949: On this date, five and one-half years after operation, the patient was well and engaged in her usual teaching position.

Pathologic Report.—The tumor was sparsely cellular and composed for the most part of moderately pleomorphic cells with ill defined cytoplasm. The matrix of the tumor was loosely reticular and fibrillar, derived in part from the tumor cells. The nuclei of the cells were often large, pale and vesicular and sometimes contained enormous nucleoli. Multinucleate cells were present. Scattered among

the large cells were a few small, poorly differentiated glial cells and cells resembling lymphocytes. Mitotic figures were rare (figs. 6 and 7). The histologic diagnosis was pinealoma.

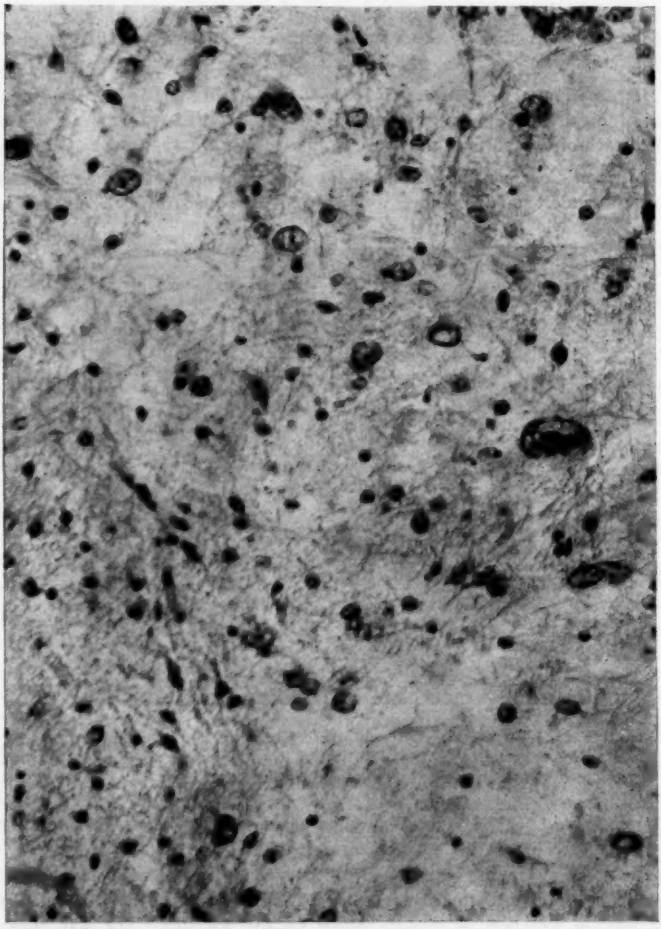

Fig. 6 (case 2).—Photomicrograph of tumor (× 244) showing general characteristics of the sparsely cellular tumor with loosely reticular matrix. Hematoxylin and eosin stain.

Comment.—This case represents the only other instance in my series of a long survival (five and one-half years) after the radical removal of a pinealoma in the usual situation. I have had a case of an ectopic pinealoma in the chiasmal region in which the tumor was removed in

1942 and the patient has been well to date (seven years after operation), but this case need not be considered in the present connection and has been reported elsewhere.[15]

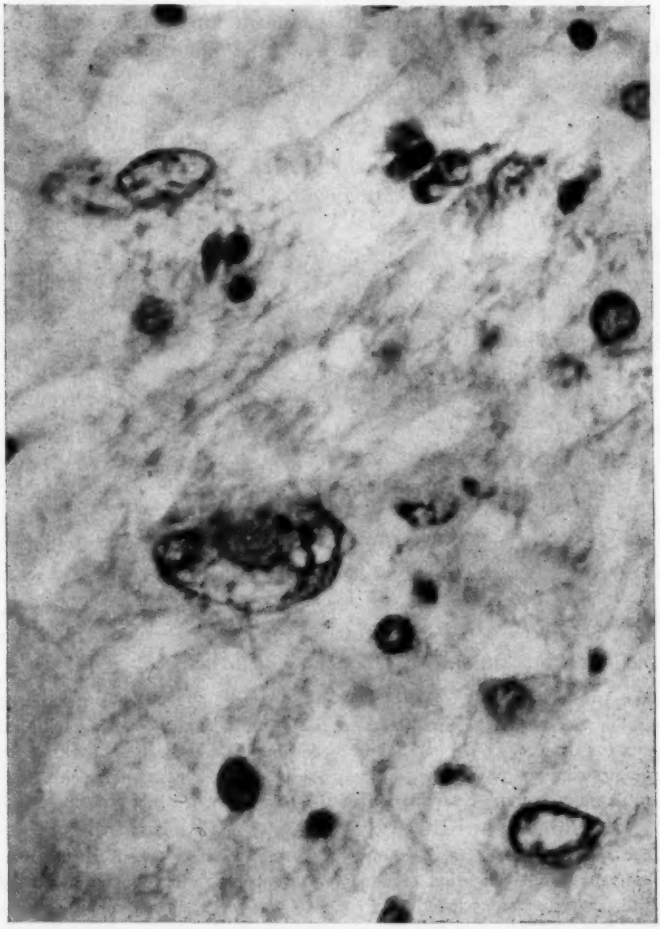

Fig. 7 (case 2).—Photomicrograph of tumor (high power), giving a detail of pleomorphic cells with large vesicular nuclei. Note the large multinucleate cell.

The circumstance to be emphasized in the case just cited is the impression at the time the operation was begun that the tumor was in the cerebellum because of inconclusive evidence from the ventriculogram

15. Horrax, G., and Wyatt, J. P.: Ectopic Pinealomas in the Chiasmal Region: Report of 3 Cases, J. Neurosurg. **4**:309 (July) 1947.

that the growth was farther forward. This error has occurred three times in the 22 cases in this series, and from a review of the records of these 3 cases it is evident that the cerebellar symptoms were outspoken and that in 2 cases the ventricular picture was not entirely clear, so that in 1 case a second ventriculogram was made after his cerebellar exploration. In the third case the projection of the tumor in the posterior portion of the third ventricle was misinterpreted.

TUMORS "VERIFIED" BY VENTRICULOGRAPHY

In 9 cases in this series a tumor projecting into the posterior portion of the third ventricle, associated with dilated lateral ventricles, was demonstrated by ventriculograms. In 5 of the 9 cases confirmatory neurologic data of a tumor in this region were present, i. e., Argyll Robertson pupils and loss of conjugate movements of the eyeballs above the horizontal plane. This combination of evidence is practically pathognomonic. In all but 1 case treatment was by decompression in the right subtemporal region followed by high voltage roentgen irradiation of the region of the presumed pineal tumor. In 3 cases death occurred one to two years after operation. In the other 6 cases the patients are well and leading active lives in their usual occupations, from two to seventeen years after decompression and roentgen therapy. The patient who was given roentgen therapy without decompression had an acute upset during the treatment, which had to be stopped temporarily; but the roentgen therapy was eventually finished, and he has been perfectly well for ten years.

Several of these cases have been reported elsewhere in different connections,[16] but 2 typical instances may be given here.

CASE 3.—R. M., a man aged 31, was first admitted to the Peter Bent Brigham Hospital on Oct. 24, 1932. His illness consisted in headaches, vomiting and blurring of vision for six weeks. He had likewise had diplopia and dizziness for four weeks. Neurologic examination showed unequal pupils, which reacted sluggishly to light and in accommodation. Examination of the fundi revealed bilateral choked disks, with an elevation of 3 to 4 D.

Operative and Roentgen Therapy.—A ventriculogram, taken on October 26, showed considerable dilatation of the lateral ventricles. The posterior portion of the third ventricle was occluded by a rounded projection, characteristic of a tumor in this region (fig. 8). For this reason, a craniotomy combined with a decompression in the right parieto-occipital region was performed on October 28. After this procedure, the patient received five series of roentgen treatments by Dr. M. C. Sosman, who furnished the details of treatment and the roentgenogram. Each series consisted of four applications of 750 r each to either side of the head,

16. (*a*) Horrax, G., and Daniels, J. T.: The Conservative Treatment of Pineal Tumors, S. Clin. North America **22**:649, 1942. (*b*) Horrax, G.: The Role of Pinealomas in the Causation of Diabetes Insipidus, Ann. Surg. **126**:725, 1947.

directed toward the pineal region. The patient was discharged on November 14, at which time the choking of the disks had subsided and he was free of headaches and other preoperative symptoms.

He remained well until December 1941, nine years after his operation, at which time diabetes insipidus developed, with an intake and output of approximately 3,500 cc. of fluid per twenty-four hours. These symptoms persisted in spite of further roentgen therapy directed toward the suprasellar and pineal regions. He has been followed at intervals up to the present time.

Report.—In July 1949, seventeen years since his operation and original roentgen treatment, the patient was in excellent health except for his polyuria and polydipsia, and was active in his regular occupation as a salesman.

Comment.—This case, that of a patient who remained in useful life after decompression and roentgen therapy for a presumed tumor of the

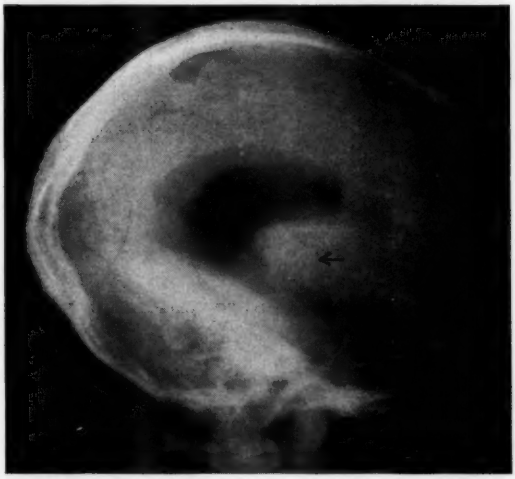

Fig. 8 (case 3).—Lateral ventriculogram showing rounded tumor projection in the posterior portion of the third ventricle (arrow).

pineal body, represents the longest follow-up record in this series. This case is the only one thus far in which diabetes insipidus developed after treatment for tumor of the pineal body, and this in spite of the fact that the patient had considerably more radiation immediately after his decompression than have subsequent patients. As I said, in commenting on his case in a previous communication [16b]:

It is possible that the water imbalance may persist because partial interruption of the nerve tract from hypothalamus to pituitary is permanent even though the tumor cells originally causing this interruption have been destroyed by the roentgen rays.

A combined craniotomy and decompression were done in this case because at the time (1932) I anticipated having to make a transventricular approach to the tumor subsequently and the hope was that the

decompression would allow the ventricle on the right side to dilate further and thus facilitate the transventricular operation. Fortunately, the latter has never been necessary.

The following case represents another instance in which, because of an inconclusive ventriculogram, a preliminary cerebellar exploration was made, without encountering a lesion.

CASE 4.—V. N., a youth aged 16, was referred by Dr. A. J. Bedell, of Albany, N. Y., and was admitted to the New England Deaconess Hospital on May 13, 1940. For six months prior to admission he had had severe headaches, nausea and vomiting, together with progressive failure of vision. Diplopia had been present at times. Neurologic examination disclosed bilateral papilledema of 6 D., bilateral paralysis of the abducens nerve and limitation of upward gaze. His

Fig. 9 (case 4).—Lateral ventriculogram showing tumor projection into the posterior portion of the third ventricle (arrow).

pupils reacted slightly to light but well in accommodation. He also showed an unsustained nystagmus, hypotonia of the arms and slight ataxia in the finger to nose test.

Operations and Result.—On May 15 a ventriculographic study was performed, but filling was not completely satisfactory; as nearly as could be told a suboccipital lesion was probable. Therefore, on the same day a cerebellar exploration was carried out, but no abnormality was found. On May 17 the ventriculographic examination was repeated, and this time an unmistakable filling defect was observed in the posterior portion of the third ventricle (fig. 9). A decompression was performed in the right subtemporal area on the same day, and he was given the usual course of roentgen therapy to the pineal region on recovery from this procedure. When he was discharged, on June 10, his decompression area was soft, and the choking of the disks had receded to an elevation of 1 D. There was likewise no limitation of upward gaze, but his pupils still reacted poorly to light.

Final Report.—The patient was seen at yearly intervals through 1946, and his general condition remained excellent. He finished school and then started in a regular occupation, which he has continued without interruption. His pupils have never regained their reaction to light, but ocular movements are normal.

A letter on June 25, 1949, nine years after operation, stated that he was in his usual good health (fig. 10).

Comment.—At the time this patient was subjected to his first ventriculographic examination, he had a serious respiratory upset, with temporary cessation of breathing, so that the filling was not as good as usual and the subsequent films were interpreted as indicating

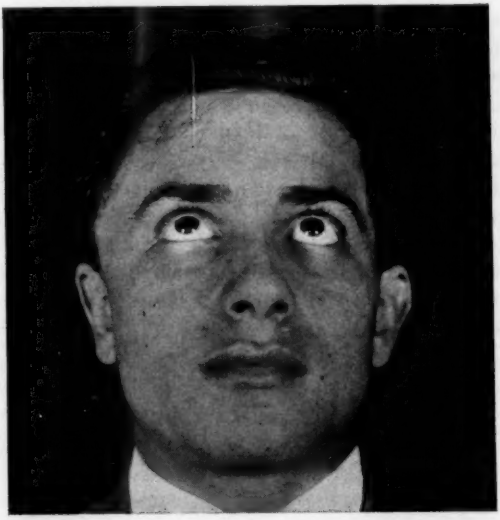

Fig. 10 (case 4).—Photograph of patient two years after operation showing unrestricted upward movement of the eyeballs.

a lesion of the posterior fossa. Such a lesion was thought to be more likely than a tumor of the third ventricle as a cause of the respiratory difficulty. It is probable that the drainage of the ventricles by catheter for two days after the first procedure was a life-saving measure.

The other noteworthy point in this patient's record was the rapid subsidence of his pressure symptoms and papilledema, as well as of the bulging and tense area of decompression following the latter operation and the roentgen therapy. Although this was likewise the result in case 3, there have been other instances in which pressure signs and symptoms did not subside until a second course of roentgen therapy, seven to eight weeks after operation.

SUMMARY

The operative and roentgenologic treatment is reviewed in a personal series of 22 cases in which the diagnosis of pineal tumor was made. In 13 cases the diagnosis was verified histologically, and in 9 it was made almost certain by localizing neurologic evidence combined with a characteristic ventriculographic picture showing the tumor projection in the posterior portion of the third ventricle.

In 2 cases of histologically verified pinealomas in which the tumors were apparently completely removed the patients are alive and well twelve and five and one-half years after operation, respectively. In 1 case of an ectopic pinealoma in the suprasellar region, histologically verified, the patient has thus far remained well, seven and one-half years after the removal of this growth.

In 6 cases the patients are alive and well (except for diabetes insipidus in 2 cases), from two to seventeen years after decompression and roentgen therapy. In these cases the diagnosis was made neurologically and ventriculographically.

In 1 case the patient remains well (except for diabetes insipidus) ten years after roentgen therapy without decompression.

The importance and far greater safety of the conservative treatment of these tumors by decompression and roentgen therapy rather than by a radical extirpation of the tumor are once more emphasized.

Dr. S. J. Hicks, of the pathological department of the New England Deaconess Hospital, described and interpreted the histologic sections of the tumors.

NATURE OF THE SCHIZOPHRENIC PROCESS

A Working Hypothesis for Therapy

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ROUGHLY a quarter of all hospital beds in this country are occupied by patients with a diagnosis of schizophrenia; yet comparatively little is understood of the essential nature of what is diagnosed as schizophrenia. Schizophrenia constitutes not only the commonest, but also one of the least understood of hospital conditions.

When Kraepelin introduced his concept of dementia precox, he stated the belief that the disorder was a progressive organic disease, after the manner of dementia paralytica. Although Bleuler's concept of schizophrenia was more flexible and made use of dynamic psychiatry in the explanation of the symptomatology, he, too, assumed an organic cause. Yet researches in neuropathology and in general pathology, diligently pursued for well over a half-century, have yielded no agreed-on characteristics beyond a somewhat higher than average frequency of certain types of structural and functional deficiencies among the patients who are called schizophrenic. Schizophrenia is not a disease with a specific organ abnormality or a specific (i. e., microbial) causal agent. It is a special type of maladaptation commonly showing a tendency to be progressive.

Adolf Meyer [1] first significantly stressed the dynamic understandability of this maladaptation in terms of the life history. Meyers' concept has been best elaborated by Cameron,[2] who characterized schizophrenia as a disorganization of the biosocial reaction systems that define personality.

Recent experimental work by Maier [3] is of special pertinence in its implications. Maier used the discrimination apparatus developed

1. (*a*) Meyer, A.: Fundamental Conceptions of Dementia Praecox, J. Nerv. & Ment. Dis. **34**:331-336, 1906; (*b*) The Dynamic Interpretation of Dementia Praecox, Am. J. Psychol. **21**:385-403, 1910; (*c*) The Nature and Conception of Dementia Præcox, J. Abnorm. Psychol. **5**:274-285, 1910-1911. The first two of the foregoing papers are reprinted in Lief, A.: The Commonsense Psychiatry of Dr. Adolf Meyer, New York, McGraw-Hill Book Company, Inc., 1948.

2. Cameron, N. A.: The Psychology of Behavior Disorders, Boston, Houghton Mifflin Company, 1947.

3. Maier, N. R. F.: Frustration, New York, McGraw-Hill Book Company, Inc., 1949.

by Lashley, with which rats are trained to jump from a perch toward one of two openings in a vertical screen, the openings being blocked by cards with different designs. If the animal jumps to the correct card, the card falls backward, and the animal is admitted into the opening and is rewarded by finding food. If the animal jumps to the wrong card, he finds it firmly fixed in place, with the result that he bumps his nose and falls into a net below.

With this apparatus, with which rats can readily be trained to discriminating responses, Maier set about investigating the effects of frustration. The rats were frustrated by making the problem insoluble. Maier found that repeated frustration resulted in a cessation of adaptive behavior and in the development of fixed responses.

These fixed responses were characterized "(*a*) by the tendency to be repeated over and over without variation and (*b*) by the property of possessing a degree of resistance to change that is not found in a learned response." For example, certain rats developed the fixed response of jumping for the right hand card. The experimenter found that he could remove the left hand card, leave the food in clear view of the rat through the left hand opening, and the rat would still jump for the right hand card, turning his body in the air in such a way as to strike the fixed card with his side, rather than bump his nose.

Abnormal fixations were found not to be subject to modification by the persistent use of punishment; such punishment merely increased the strength of the fixation. Fixations occurred more rapidly if punishment was given on every trial than if it was given on half the trials and reward on the other half.

Maier found evidence that fixation of response has an adjustment value in the sense that it appears to relieve tensions within the experimental animal. Some rats responded to an insoluble problem by the development of convulsive seizures. Maier found evidence that the development of a fixed response reduces the tendency to respond to an insoluble problem by the development of seizures.

The work of Maier demonstrates that repeated frustration pushed beyond the tolerance of the animal results in a replacement of adaptable behavior by stereotyped, nonadaptable responses, or "frustration behavior," as Maier called it. Maier's frustrated rats failed to adapt to the open window and the food in clear view. They would react to the food in that they would sniff it and reach out toward it, but when forced to jump they would not jump for the food but would repeat their stereotyped pattern of jumping to the other opening, blocked by its locked-in card. They failed to react adaptively to the obvious.

Pavlov [4] earlier described stereotyped, and even cataleptic, responses in dogs with salivary conditioned reflexes plus inhibitory conditioning

4. Kasanin, J.: Pavlov's Theory of Schizophrenia, Arch. Neurol. & Psychiat. 28:210-218 (Aug.) 1932.

when both types of signals were given in immediate (and hence contradictory) succession over a period of time. Paradoxic inhibition might develop and last several days. Saliva would flow at the conditioned stimulus, but when the dog was given food he would turn to it but would not eat it. Pavlov related the behavior he observed to the phenomena of schizophrenia. Masserman [5] also reported the development of stereotyped behavior in frustrated animals.

Patrick [6] found that increased stereotypy of response, "implastic and unadaptive" behavior, tended to replace rational behavior in the problem solving of human adults under the "distracting" stimulation of electric shock, cold shower or horn. Beier [7] found that the experimental creation of anxiety resulted in rigidity and disorganization in perceptual fields, as determined by tests of abstract reasoning, sorting and minor drawing and by the Rorschach test.

There is widespread evidence that the schizophrenic person is one who has passed his threshold of tolerance for frustration and has as a result begun to react in nonadaptable, and consequently maladaptive, ways.[8] Since maladaptation inevitably leads to further frustration, the process is typically progressive. In schizophrenia behavior previously fluid and adaptive becomes progressively frozen in maladaptive or "regressive" patterns.

Studies of the family background of patients with schizophrenia and schizoid personalities reveal cohesive families to be typical [9] but suggest

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5. Masserman, J.: Behavior and Neurosis, Chicago, University of Chicago Press, 1943.

6. Patrick, J. B.: Studies in Rational Behavior and Emotional Excitement: I. Rational Behavior in Human Subjects, J. Comp. Psychol. **18**:1-22, 1934; II. The Effect of Emotional Excitement on Rational Behavior in Human Subjects, ibid. **18**:153-195, 1934.

7. Beier, E. G.: The Effect of Induced Anxiety in Some Aspects of Intellectual Functioning: A Study of the Relationship Between Anxiety and Rigidity, Am. Psychologist **4**:273-274, 1949.

8. Freud stated: "There always remains as a common feature in the etiology both of the psychoneuroses and the psychoses the factor of frustration—the lack of fulfillment of one of those eternal uncontrollable childhood's wishes that are so deeply rooted in our composition, phylogenetically foreordained as it is. . . . Now the pathogenic effect depends upon whether, in the tension of such a conflict, the ego remains true to its allegiance to the outer world and endeavors to subjugate the id, or whether it allows itself to be overwhelmed by the id and thus torn away from reality." (Freud, S.: Neurosis and Psychosis: Collected Papers, London, Hogarth Press, 1946, vol. 2, pp. 253-254).

The foregoing statement still appears valid in the light of present knowledge but does not seem to give sufficient consideration to the frustrations resulting from conflicting reality demands.

9. (*a*) Tietze, T.: A Study of Mothers of Schizophrenic Patients, Psychiatry **12**:55-65, 1949. (*b*) Jenkins, R., and Glickman, S.: Common Syndromes in Child Psychiatry: II. The Schizoid Child, Am. J. Orthopsychiat. **16**:255-261, 1946.

early frustration of a growth toward independent selfhood. Certain tendencies appear with a disproportionate frequency. Tietze [9a] described the mothers of 25 schizophrenic patients as perfectionistic, righteous, dominating, and most typically subtly dominating. Jenkins and Glickman [9b] found the mothers of schizoid children typically perfectionistic, with indication that they are likely to have a close, but harsh, relationship with the schizoid child. Despert [10] described the mothers of schizophrenic children as "aggressive, overanxious, oversolicitous" and with a strong ambivalence, which she interpreted as indicating a profound underlying rejection. Kasanin and associates [11] reported overprotection as the characteristic pattern, an overprotection which he considered stimulated in part by the child's special needs, but as hindering his emancipation from his parents and his psychosexual development. There is much in common between these characterizations, particularly if one pays attention to the description rather than to the interpretation, since opinion varies with respect to the latter. It will be evident that any one of them describes an overpowering parent with whom it would be more than usually difficult for a child to establish his individuality, his self, without doing so through negativism or schizoid withdrawal. Plant [12] graphically describes such behavior.

> Some time ago a five-year old boy came to the Essex Clinic, the only child of an intelligent, finger-in-everybody's-pie sort of mother. For one of his age he could stand for unbelievably long periods without apparent movement of any sort. He once stood in this catatonic fashion for over twenty minutes following his mother's pleasant but rather urgent insistence that he "take his coat off" (precisely the activity in which he was busily engaged at the time she spoke). Today this symptom has entirely disappeared, the boy does well at school and in dancing-class; reports come of his freedom of movement at home, on the playground, and in school. This has come about with a minimum of contact, on our part, with the patient. Indeed, such contact as we had, produced only what was described above—complete negativism—as we were but another group of interfering adults.

Lidz and Lidz,[13] in a study of the family environment of 50 schizophrenic patients, while not minimizing the importance of the mother, emphasized the importance of the paternal influences. "In our data it is apparent that the paternal influences are noxious as frequently as are the maternal." The pathologic influences they found were gross rather than subtle.

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10. Despert, J.: Prophylactic Aspect of Schizophrenia in Childhood, Nerv. Child **1**:199-236, 1942.

11. Kasanin, J.; Knight, E., and Sage, P.: The Parent-Child Relationship in Schizophrenia: I. Overprotection-Rejection, J. Nerv. & Ment. Dis. **79**:249-263, 1934.

12. Plant, J. S.: Personality and the Cultural Pattern, New York, The Commonwealth Fund, 1937, pp. 34-35.

13. Lidz, R., and Lidz, T.: The Family Environment of Schizophrenic Patients, Am. J. Psychiat. **106**:332-345 (Nov.) 1949.

The study of the histories of these patients impresses . . . that one patient after another was subjected to a piling up of adverse intrafamilial forces that were major factors in moulding the misshapen personality, and which repeatedly interfered with the patient's attempts at maturation in a most discouraging fashion.

Schizoid withdrawal is a frequent precursor of schizophrenia. The quality of schizoid behavior in interpersonal relations is much more easily sensed than described. Its essence seems to be a lack of attention to and of reactivity to the nonverbal cues to feeling and thinking for which one normally watches. In social relations the normally reacting person is not only listening to words; he watches expression, movement, gesture. He picks up cues from intonation, stress, action, choice of words. He is alert to reversals of meaning implied by a tone of sarcasm or irony. He is alive to many impressions, the sources of which he could describe or analyze only very imperfectly, if at all. Typically he will describe the results of these observations in terms of his sensing feelings rather than in terms of describing actions. "She seemed pleased underneath it all." "His laughter seemed forced." "He was very controlled, but you felt he was angry."

The schizoid manner is recognized by the normal person and is described in feeling language, typically without clear perception of what brings about the impression. "He seemed to be in another world." "You felt he might as well have been on Mars." "It was as though we were talking through a glass wall." "Somehow you felt he wasn't really there." "He didn't seem to feel I existed."

Schizoid withdrawal is a relative withdrawal of attention and interest from the outer environment, particularly a withdrawal from emphatic contact with the human environment.[14] Such withdrawal is often not uniform; some degree of empathy may be maintained with selected persons while it is withdrawn from others. This withdrawal from emotional contact with others is the most important phase of a broader withdrawal from reality and abandonment of the practice of reality testing. In the process of emotional withdrawal the capacity to sense the feeling of another in the fashion which has been described is lost long before the capacity to comprehend and to respond to his spoken language.

14. "In schizophrenia, on the other hand, we have been obliged to assume that after the process of repression the withdrawn libido does not seek a new object, but retreats into the ego; that is to say, here the object-cathexes are given up and a primitive object-less condition of narcissism is re-established. The incapacity of these patients for transference—so far as the process of the disease extends—their consequent inaccessibility to therapeutic efforts, the repudiation of the outer world characteristic of them, the manifestations of hyper-cathexis of their ego, the final outcome in complete apathy—all these clinical features seem to accord excellently with the assumption that object-cathexes are relinquished." (Freud, S.: The Unconscious, Collected Papers, London, Hogarth Press, vol. 4, pp. 128-129.)

Some observations would indicate that the child who becomes schizophrenic is likely to have had less than usual opportunity to develop emotional resonance in his early relation with his parents. Tietze [9a] reported that it is the community of feeling or "empathy with the child that appears to be missing or inadequately developed in the relationship of the mothers here under discussion to their schizophrenic children."

If one asks oneself why certain persons who have previously been normally extroverted show schizoid withdrawal, one finds clear evidence that this type of reaction occurs in persons who find the world of reality too frustrating. In the words of Plant,[15] "Where currents of the environment sweep too freely and too drastically through the personality, it uses the mechanism of 'negativism' to shut out these devastating influences."

Cameron [16] stated:

> Practically all persons developing schizophrenia have for one reason or another relied heavily upon fantasy as a technique for overcoming frustration, gaining rewards, resolving conflicts and taking revenge.

In our society, and perhaps in most others, the area of greatest human frustration is typically that of interpersonal relationships. Phenomena similar to, if not identical with, schizoid withdrawal were described by Henry [17] in old people among the Pilaga Indians, who live in a society in which there is intense culturally sanctioned hostility toward the helpless aged as an uncompensated drain on a marginal food supply.

Various signs which have been recognized as typically precursors of schizoid withdrawal tend to be identical with signs which have been demonstrated to have unfavorable prognostic import in schizophrenia. They relate to the absence of interests and of technics for obtaining satisfaction in the real world, or to weakness of motivation. Lack of indication of hobbies, talents or interests is often a precursor of schizoid withdrawal.[9b] Defect of interest and limited range of interests are unfavorable prognostic signs in schizophrenia.[18]

The trait of seclusiveness, the "shut-in" personality and related behavior, as a precursor of schizophrenia has been widely remarked.

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15. Plant,[12] p. 16. There is an excellent discussion of the protective walling off of the personality on pages 121-122.

16. Cameron,[2] p. 486.

17. Henry, J.: Anthropology and Psychosomatics, Psychosom. Med. **11**:216-222, 1949.

18. Wittman, P.: A Scale for Measuring Prognosis in Schizophrenic Patients, Elgin Papers, from the Elgin State Hospital (published with the approval of the Department of Public Welfare), vol. 4, 1941, pp. 20-33. Wittman, P., and Sternberg, L.: Follow-Up of an Objective Evaluation of Prognosis in Dementia Praecox and Manic-Depressive Psychoses, ibid. vol. 5, 1944, pp. 216-227.

Lack of satisfactory social participation is reflected in inability to get along with other children, preference for younger children and absence of close friendships, which appear with a disproportionate frequency in schizoid children [9b]; in lack or inadequacy of early socioaffective rapport in schizophrenic children [10]; in the few friendships, emotional distance from other members of the family, solitary recreation and close-mouthedness of children who become schizophrenic in adult life [18] and in the "constitutional personality of the shut-in type," schizothymic personality and lack of heterosexual contacts which are unfavorable prognostic signs in the schizophrenic patient.[19] A low energy level, lack of drive, is a further unfavorable prognostic sign.[18]

Frustration is a universal human experience, and every one must handle some degree of frustration in his daily life. A common source of frustration is a disproportion between aspiration and achievement. Adolf Meyer [20] stated:

> The greatest difficulty in life, the greatest source of disharmony, apart from the influences of heredity, infectious disease and poor feeding and poor chances for growth, is the discrepancy between impulse, yearning and ambition, on the one hand and the actual opportunities and the actual efficiency of performance on the other. We know people who try continually to put square pegs into round holes. They are unable or unwilling to learn to know and to accept their own nature and the world as it is, and to shape their aims according to their assets.
>
> In a large percentage of cases in which persons come to grief in their mental and moral health, the trouble is of just that kind. Failing with what is frequently impossible and undesirable anyhow, these persons develop emotional attitudes and habits and tendencies to fumble or to brood or to puzzle or to be apprehensive until what students of the functional diseases of the heart call "a break of compensation" occurs, a break of nature's system of maintaining the balance, with a more or less sudden slump and implication of collateral functions.

Jenkins and Glickman [9b] found a reliable tendency for schizoid children to have a performance intelligence quotient 10 points or more below their Stanford-Binet (largely verbal) intelligence quotient. There have been many reports indicating that schizophrenic persons have relatively poor practical or performance intelligence as compared with their vocabulary level. Poor practical or performance intelligence as compared with verbal intelligence tends to be associated with frustration, for aspiration levels tend to be arrived at and defined verbally. When practical performance fails to reach aspiration levels defined in verbal symbols, symbolic activity tends to be further developed as a compensation for poor practical performance.

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19. Bowman, K.: A Study of Pre-Psychotic Personality in Certain Psychoses, Am. J. Orthopsychiat. **4**:473-498, 1934.

20. Jennings, H. S., and others: Suggestion of Modern Science Concerning Education, New York, The Macmillan Company, 1917, pp. 201-202.

Schizophrenic patients as a group have experienced relatively little success in school. Jenkins and Glickman [9b] found in their study indications that schizoid children show both superior intelligence and school retardation more frequently than children in child guidance clinics in general. Kendig and Richmond [21] found a history of poor school work and retardation in school in their patients. Poor performance in school with attendant frustration is only one piece in a broad mosaic of poor performance and attendant frustration in the early background of schizophrenic patients. Terry and Rennie,[22] from their study of 77 schizophrenic patients, stated:

> We see in these patients, as they approach the years of synthesis, one avenue of satisfaction after another closed by virtue of personal sensitiveness, crippling experiences and memories. They progressively fail to achieve satisfaction either in their more personal-familial relations, or later in their broader group, school, social and sexual adjustment. It is this progressive failure in deriving satisfaction from growing and assertive needs that stands out predominantly in the early lives of most of these patients.

Cameron [16] has well characterized the persons in whom schizophrenic breakdown occurs.

> Schizophrenic disorganization and desocialization develop most readily in anxious solitary individuals who are socially immature as well as socially inept.

One may consider four reactions to the classic and common conflict between sexual desire and intense puritanic moral training, as this conflict comes into prominence with the hormonal push of adolescence. It is not suggested that all individuals can be fitted into one of these reaction types, but representatives of each are easily found.

1. The sexual hunger and the striving for close affectional ties and for emotional resonance and security may be effectively integrated with the individual's morality in the constructive synthesis of a successful courtship and successful marriage. This requires a high order of adaptive skill.

2. The individual may strive toward this achievement, but the integration may be ineffective, with or without marriage, and the resultant compromise solution may be the source of conflict and frustration.

3. The individual may suppress his sexual interest and even repress his sexual drive more or less effectively. This is a potentially neurotic adaptation, for his sexual drive may still shape his behavior in ways

21. Kendig, I., and Richmond, W.: Psychological Studies in Dementia Praecox, Ann Arbor, Mich., Edwards Brothers, Inc., 1940.

22. Terry, G. C., and Rennie, T. A. C.: Analysis of Paregasia, Nervous and Mental Disease Monograph 64, New York, Nervous and Mental Disease Publishing Company, 1938.

of which he is unconscious, and the repression may result in neurotic symptom formation. What begins as an adaptation may become a neurotic maladaptation, and he may show neurotic symptom formation.

4. The individual may be so frustrated by his conflicting drives and by his painful selfconsciousness and lack of social skill that his limited and overtaxed capacity to deal with the situation disintegrates. He cannot synthesize, compromise or repress. His threshold of frustration tolerance is passed. He cannot handle or adapt to the situation, and a maladaptive process sets in, not beginning in the peripheral zone of drives or desires banished from consciousness, but centering in processes which are the very essence of the self. The forebrain function of discrimination fails, and his perception of reality becomes distorted. He shows schizophrenic symptoms.

From this it may reasonably be expected that unconscious motivation does not have in schizophrenia the importance it has in the psychoneuroses. Repression does not play the present role in schizophrenia that it does in the neuroses. In freudian terms, the ego is not the ally of the outer world in repressing the id, but rather may be the ally of the id in distorting the outer world. Freud [23] stated:

> Neurosis is the result of a conflict between the ego and its id, whereas psychosis is the analogous outcome of a similar disturbance in the relation between the ego and its environment (outer world).

It might be added that in psychosis the conflict results in a disorganization of the ego. It is therefore not surprising that the classic method of psychoanalysis is without value in schizophrenia.[24]

Meyerson [25] emphasized the anxiety, inner turmoil and frustration which social scrutiny creates in the preschizophrenic person and emphasized what he called the derision complex, and the prominence of ideas of reference in the symptomatology of schizophrenia. Dunham [26] emphasized the prominence of selfconsciousness, anxiety and seclusiveness in the background of the catatonic patient, thereby extending the earlier work of Favor [27] who found seclusiveness to be the outstanding trait in these persons. Cameron [28] presented understandably and per-

23. Freud, S.: Neurosis and Psychosis, Collected Papers, London, Hogarth Press, 1946, vol. 2, pp. 250-251.

24. Freud, S.: On Narcissism, Collected Papers, London, Hogarth Press, 1946, vol. 4, p. 31.

25. Meyerson, A.: Scrutiny, Social Anxiety and Inner Turmoil in Relationship to Schizophrenia, Am. J. Psychiat. **105**:401-409, 1948.

26. Dunham, H.: The Social Personality of the Catatonic-Schizophrene, Am. J. Sociology **49**:508-518, 1944.

27. Favor, H. E.: A Study of the Personality in Persons Developing Catatonic Dementia Praecox, Psychiatric Quart. **6**:500-503, 1932.

28. Cameron,[2] pp. 485-492.

suasively the profound frustration and inability to cope with life which often recognizably precede the development of schizophrenia.

Schizoid withdrawal may be both protective and assertive in a sense. It affords some measure of protection from either domination or derision. It provides an inviolate area for the expression of individuality, the expression of self. Apathy, which seems clearly related to schizoid withdrawal, is reported in adults subjected to a long period of extreme external repressive stress, as were the surviving inmates of German concentration camps [29] and the American prisoners of war in Japanese hands.[30] It is also reported in young children growing up in a grave dearth of social stimulation and affectional response.[31]

If one accepts a view of schizophrenia as a potentially progressive maladaptation produced by frustration beyond the capacity of the patient to sustain, then a number of elements follow. The difference between a "schizophrenic process" and a "schizophrenic reaction" becomes simply a matter of degree. A patient whose adaptive capacity gradually and insidiously crumbles without special strain certainly may be expected to offer a less favorable prognosis for the reversal of the process than one whose breakdown is sudden and under unusual emotional or physical stress. Acute onset, particularly under stress or with a precipitating factor, has generally been found to be of favorable prognostic significance.[32] It is worth remarking that Rennie [33] reported finding definite precipitating events in 73 per cent of a series of 500 cases of schizophrenia.

It is of interest that the incidence of schizophrenia in our cities follows a diminishing gradient as one moves away from the center of the city. The relatively chaotic high stress, poverty-stricken slum areas of our cities have several times as many hospitalized schizophrenic patients for their population as have the better residential areas.[34] Manic-depressive psychosis, on the other hand, does not show such

29. Freedman, P.: Some Aspects of Concentration Camp Psychology, Am. J. Psychiat. **105**:601-605, 1949. Greenson, R. R.: The Psychology of Apathy, Psychoanalyt. Quart. **18**:290-302, 1949. Bettelheim, B.: Individual and Mass Behavior in Extreme Situations, J. Abnorm. & Social Psychol. **38**:417-452, 1943.

30. Brill, N. Q.: Neuropsychiatric Examination of Military Personnel Recovered from Japanese Prison Camps, Bull. U. S. Army M. Dept. **5**:429-438, 1946.

31. Spitz, R. A.: Hospitalism, in Brody, S.: The Psychoanalytic Study of the Child, London, Imago Publishing Co., Ltd. **1**:53, 1945; **2**:113, 1946.

32. Chase, L. S., and Silverman, S.: Prognostic Criteria in Schizophrenia, Am. J. Psychiat. **98**:360-368, 1941.

33. Rennie, T. A. C.: Prognosis: Follow-Up Study of 500 Patients with Schizophrenia Admitted to Hospital from 1913 to 1923, Arch. Neurol. & Psychiat. **42**:877-891 (Nov.) 1939.

34. Faris, R. E. L., and Dunham, H. W.: Mental Disorder in Urban Areas, Chicago, University of Chicago Press, 1939.

an ecologic pattern. Malzberg [35] reported an incidence of schizophrenia (based on hospitalized cases and standardized for age) of 16.9 per 100,000 for native white persons of native parentage, 26.4 for native white persons of foreign parentage and 32.8 for foreign-born persons and 51.1 for Negroes. The urban rate is 2.1 times the rural rate. Schizophrenia rates are high for the single and the divorced, and lower for the married. Granted that distinctly schizoid persons may find it more difficult to marry and to stay married, nevertheless, schizophrenic breakdown is associated with the situation of greater frustration, if singleness is assumed to be typically more frustrating than matrimony.

Schizophrenic withdrawal, with the attendant cessation of reality testing, is doubtless a contributing factor, along with the patient's incapacity to deal with his life situation, in the typical progressive development of the schizophrenic thinking disorder. The interpretation of proverbs and fables provides to some degree an indication of the presence of a schizophrenic thinking disorder.[36] The proper interpretation of proverbs and fables (unless it comes merely from memory) demands a good grasp of reality. Proverbs and fables are concrete in form and abstract in meaning. Their interpretation involves a synthetic process of picking from life experience generalizations for which the concrete figures of the proverb or fable may serve as effective symbols. Such selection may result in approximations of truth sufficiently penetrating or useful to pass as wisdom. In schizophrenia, symbolization loses, to a greater or less degree, its function of facilitating adaptation to the world of reality and continues on the autistic level as a compensatory activity into which the patient retreats. With this change, the capacity to distinguish between symbol and substance diminishes. The metaphor tends to be understood literally.[37] The broader meaning of the proverb or fable is missed or distorted. As a result of the progressive failure to check the thinking processes with reality, the thinking processes begin progressively to lose their correspondence with reality. The capacity to detect absurdities deteriorates, and thinking is more and more dominated by the strange, illogical, incongruous, twist- and-fancy-born private meanings of the schizophrenic patient. The end result of such progressive maladaptation is the deterioration and dilapidation of the severely "regressed" hebephrenic state. But the "content disorder," the manifestly disordered and delusional thinking of the schizophrenic patient, is a secondary rather than a primary product.

35. Malzberg, B.: Social and Biological Aspects of Mental Disease, Utica, N. Y., State Hospitals Press, 1940.

36. Wegrocki, H.: Generalizing Ability in Schizophrenia: An Inquiry into the Disorders of Problem Thinking in Schizophrenia, Arch. Psychol. vol. 36, no. 254, 1940.

37. Muncie, W.: The Psychopathology of Metaphor, Arch. Neurol. & Psychiat. 37:786-804 (April) 1937.

The whole gamut of thinking disorder characteristic of schizophrenia becomes much more comprehensible when one considers the effects of autistic withdrawal and the cessation of reality testing.

The various subgroups of schizophrenia become groups distinguished only by the relative prominence of particular symptoms. Where schizoid withdrawal becomes actively defensive, in a relatively organized personality, one speaks of a catatonic type. Possibly it would be better to speak of a catatonic phase.

Aggressive responses are more likely to occur in persons well equipped, physically and temperamentally, for effective aggression. These are the persons of good muscular development (the "mesomorphs" of Sheldon and associates [38]), and of active aggressive temperament (the "somatotonics" of Sheldon and Stevens [39]). Wittman, Sheldon and Katz [40] reported a correlation of +0.536, within a hospitalized psychotic group, between paranoid component and "mesomorphy" and a correlation of +0.688 between paranoid component and "somatotonia." Those persons not well equipped for physical aggression, but presumably well equipped for and disposed toward cerebral activity, and presumably thereby disposed toward autistic retreat, tend toward the withdrawal and reality distortion of the hebephrenic process. The same authors found the correlation of +0.542 between the heboid component and ectomorphy (slender body form related to relative prominence of tissues developed from ectoderm—skin and nervous system) and a correlation of +0.808 between the heboid component and "cerebrotonia," the characteristic of personality inhibition ascribed to the functional dominance of cerebral structures. The ectomorphic person is endowed with a constitution in which much has been staked on discriminating adaptive capacity, less on the (mesomorphic) strength to attack or on the (endomorphic) good digestion. When the ectomorphic person's capacity to adapt breaks down, the picture is typically hebephrenic,[41] and the prognosis is poorer than with a patient of broader body build.[42] There

38. Sheldon, W. H.; Stevens, S. S., and Tucker, W. A.: The Varieties of Human Physique, New York, Harper & Brothers, 1940.

39. Sheldon, W. H., and Stevens, S. S.: The Varieties of Temperament, New York, Harper & Brothers, 1942.

40. Wittman, P.; Sheldon, W. H., and Katz, C. J.: A Study of the Relationship Between Constitutional Variations and Fundamental Psychotic Behavior Reactions, J. Nerv. & Ment. Dis. **108**:470-476, 1948.

41. Wittman, Sheldon and Katz.[40] Sheldon, W. H.; Hartl, E. M., and McDermott, E.: Varieties of Delinquent Youth, New York, Harper & Brothers, 1949.

42. According to this hypothesis, schizophrenia is not inherited, although a predisposition to it may be. The substantial evidence to show that schizophrenia is to a prominent degree a familial disease does not establish factors of biologic heredity as determining. The demonstration of a strong familial resemblance in choice of political party does not establish that this is determined by biologic

is substantial literature from the past to indicate an affinity between schizophrenia and the slender ectomorphic (Sheldon) or leptosomic (Kretschmer) body form.

Typically, the paranoid patient does not "regress" as far as the hebephrenic patient. With his reactions of suspicion and hostility, the paranoid patient morbidly projects, but the very nature of his reaction tends to keep him from withdrawing to the extent characteristic of the hebephrenic patient. The closer contact he maintains with the real world, even though it is a morbid contact, tends to protect him from the extreme loss of correspondence between thinking and reality which tends to become characteristic of the hebephrenic patient.

The factor of age is undoubtedly also significant for the psychotic symptoms tend to develop at a later age in paranoid patients than in patients of the hebephrenic type or with simple schizophrenia. As Cameron [43] pointed out, the patient who is older at the onset of his illness should have a better established and less easily disorganized life pattern than one who is younger.

Whether or not there is a qualitative (as against a quantitative) difference in paranoid schizophrenia, the paranoid state and paranoia may be seriously questioned. At one end of the scale the pathologic process is more strictly confined to projection than at the other.

In a sense, schizophrenia must represent a breakdown in the functional interrelation of the forebrain and the action structures. In catatonic withdrawal this may be viewed as an active process in which the forebrain protects itself from stimuli which have become disorganizing to its normal function. In hebephrenic dilapidation one sees an end product of forebrain dysfunction.

From a biologic and evolutionary point of view the endodermal, or digestive, system is in a sense more fundamental than the mesodermal, or muscular, system. The elaboration of the latter system was essentially an aid or adjunct to the digestive system.

Some of the invertebrates consist of little more than a digestive tract, and even among the mammals one finds species and individuals with a relative anatomic and functional dominance of one embryonic layer or another. The omnivorous swine depends substantially on his capacity to digest what he can get; the carnivorous weasel, on his capacity to get what he can digest. The one appears to focus on the enjoyment of eating and readily grows fat and relaxed. The other seems to focus on the enjoyment of killing and remains lithe, muscular

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heredity. The high correspondence in the development or nondevelopment of schizophrenia in pairs of twins reared together must be weighed against the extremely close psychologic identification and emotional ties which are typical of such pairs, as compared with fraternal twin pairs.

43. Cameron,[2] pp. 489-491.

and savage. As compared with the other mammals, man stakes more on the elaboration of his ectodermal structures, particularly the cerebral hemispheres, and less on either endodermal or mesodermal structures. Man's ascendancy is certainly due to the development of finely discriminating responses rather than to digestive or to muscular prowess. In this sense man owes his ascendancy to ectodermal structures.

The reliance on the forebrain tends to reduce the immediacy of response to many stimuli, because it interposes a discriminatory process which may be complicated. Directness and immediacy of response are subordinated to discrimination. Particularly in new or unfamiliar situations the discriminatory process is likely to result in indecision and delay. At its best the forebrain produces an intelligently discriminating and effective channeling of action; at its worst it produces indecision, uncertainty and attendant inhibition of action—the tragedy of Hamlet. Great intellectualizing about a problem is oftener associated with doing little about it than with doing much about it. Just as man's greatest asset is the function of his forebrain, one of his greatest liabilities is the dysfunction of his forebrain. There appears to be some justification for Sheldon and Stevens'[39] association of the inhibited "cerebrotonic" temperament with the "ectomorphic" body build.

When the inhibitory and discriminating apparatus of the forebrain goes wrong, the patient may be better off without it. More limited capacity for conceptualizing may be less damaging to the organism than the tension of chronic intrapsychic conflict. The various operations of frontal leukotomy appear to have the effect of partially freeing the lower centers from both chronic tension and anxiety related to forebrain function and dysfunction and from forebrain inhibition. From the descriptions available it would seem that problems relating primarily to chronic anxiety tend to disappear and that problems relating to defective inhibition may increase. The personality apparently becomes less introspective, less self concerned, more occupied with the present, more stimulus bound or stimulus dependent. With leukotomy procedures, the significance of the past and the future apparently fades, and the capacity of the personality to bind time reflectively apparently diminishes.

A hypothesis that schizophrenia is a progressive maladaptation occasioned by frustration beyond the tolerance of the individual accounts for the absence of specific cellular abnormalities in the schizophrenic patient, for the fact that the development of the disorder is frequently related to a family background[42] which might be expected to make the establishment of independent personal adequacy difficult and for the tendency of the disease to develop either gradually, after a period of perceptible failure of social adaptation, or more suddenly, under the pressure of increased environmental strain. It accounts for the recog-

nized progressive rise in the rate of schizophrenia as one moves from situationally favored groups to those under more stress or subjected to more frustration. It accounts for the existence of unfavorable and favorable prognostic signs. It accounts for schizophrenic withdrawal and is in harmony both with the typical emotional flattening and with the thinking disorder of the schizophrenic patient. It accounts for the fact that the schizophrenic process, while typically progressive, may at any time be reversed, and for the fact that the longer the patient has been ill, the less the likelihood is that it will in fact be reversed. It accounts for the fact that the recovery of the schizophrenic patient may be incomplete, with areas of frozen or frustration behavior remaining. It is difficult to aid the patient to find ways to obtain satisfaction in all areas. It is implicit in this hypothesis that a greater degree of adaptive success is necessary to bring about the recession of "frustration behavior" once this has occurred than merely to maintain adaptive effort. In the words of Adolf Meyer,[1b] "Where a break or morbid reaction has once set in, it is very difficult to bring relief directly."

THERAPY

The foregoing hypothesis that schizophrenia is a progressive maladaptation resulting from frustration beyond the tolerance of the patient has certain implications for therapy. It provides us as psychiatrists with a rationale for many things we are already doing. It permits us to sharpen our thinking. This, in turn, should permit us either to improve our practice or to discover inadequacies in our hypothesis.

With this hypothesis, the objective of therapy is easily defined operationally. It is to reverse the maladaptive process. It is to relieve frustration and simplify the situation to the point where the patient can achieve success and satisfaction in his efforts and replace frozen, maladaptive behavior ("frustration behavior") with flexible, fluid adaptation to the current realities of his environment. We have as an example the fact that after Maier had brought about fixed "frustration behavior" by confronting his rats with an insoluble problem, and when they became incapable of learning discriminatory responses in the Lashley apparatus, he was able quickly to overcome the fixation and reestablish adaptive learning behavior by what he called guidance—by interposing his hand a few times in such a way as to prevent the rat from repeating his stereotyped pattern of jumping to his habitual window, and pushing or carrying him toward the other window, which might either be left open or be closed by the correct card.

The first step in therapy is to seek to diminish the patient's frustration. If the schizophrenic symptoms have developed under conditions of unusual and relievable external strain, this is easily done, and the

prognosis is correspondingly favorable. If the symptoms have developed insidiously, with no unusual or relievable external strain, this may be extremely difficult to achieve, and the prognosis will be correspondingly less favorable. Recognition should be taken of the fact that the most significant frustrations are typically in the patient's closer and more significant interpersonal relationships, or in the lack of such relationships.

The simplification of a baffling social situation is of the essence. If the symptoms are relatively mild, and the patient can be temporarily relieved in the most frustrating of his adjustment problems by relief of external strain, he may quickly recover, particularly if he has psychiatric help of an understanding and supportive kind. Some patients may effectively be treated on an outpatient basis. In the treatment interview, the therapist has the opportunity to extend to the patient a relation so managed as to provide support, to make minimal demands and to give quick and generous recognition for whatever elements of constructive adaptive response the patient may show. If these are sufficient to reverse the process, a later phase of the therapy will, as a rule, focus on the adaptations the patient can make in dealing with the major frustrating elements in his life situation.

In many cases hospitalization is indicated or unavoidable. While it may initially constitute a shock and a further frustration to the patient, it provides a more sheltered and sheltering milieu in which there is favorable opportunity to assist the patient to reestablish his adequacy.

Since the central element, broadly defined, is the experiencing of satisfaction from some area of adaptive behavior, it is easy to see why the reversal of the process may begin in almost any area of activity—occupational therapy, games, music, artistic expression or writing, interpersonal or group relationships. It is well for us to bear in mind that typically the schizophrenic patient's capacity to deal with things is less impaired than his capacity to deal with ideas, and that the area of emotional relationships with others is usually particularly difficult for him. In most instances the use of his hands in handicraft or the use of his muscles in physical games offers the most readily available avenue for him to gain satisfactions from adaptive behavior. Since a great deal of the satisfaction normally obtained from these activities is the recognition of others, it goes without saying that such recognition should be given liberally for the most modest achievements.

A humane and enlightened general hospital program which minimizes frustration and makes as pervasive as possible the encouragement and reward of motivated behavior will in and of itself slow the process of progressive maladaptation for most patients, check it for many and reverse it, thereby converting it into progressive recovery, in some.

Good hospital personnel in many cases achieve with patients something akin to this "guidance" of Maier, and this may lead to reestablishment of adaptive behavior. In the words of Adolf Meyer [1b]:

> As soon as the patients feel that they meet with help instead of an argumentative and corrective attitude, they can be led considerably when the time comes or where the difficulty has not led to complete blocking. Then a positive reeducation in the form of habit training and of readjustment has to set in.

In addition to the general hospital programs, there are the special activity programs known as "total push." [44] These planned, intensive activity programs have many advantages and therapeutic results. The occasional rapid progress of schizophrenia in patients in a total push program is indication, however, that the push may in some cases increase frustration. Perhaps a "total coax" program would be preferable to a "total push" program. In any event, it will be worth our while carefully to study the experience and acquired wisdom of the nursery school teachers, who have perhaps the most comparable task of dealing in a group situation with persons of low frustration tolerance and limited social adequacy.

In addition to the varied activity program of the hospital, shock therapy has proved of value. Its use is empiric and has no accepted rationale. It would seem probable that its value centers in the disruption of the patient's fixed or stereotyped pattern of "frustration behavior" and that it thereby opens the door to readaptation. Nielsen and Thompson [45] expressed essentially this concept:

> We believe that the shock therapies produce a physiologic disruption of newly-formed (psychotic) or mal-functioning engrammes. With their disruption the normal neurophysiologic processes have the opportunity to be restored.

For treatment to be effective, the rupture of such patterns must be followed by the establishment of adaptive motivation responses. The greater success of insulin shock than of electric shock in the treatment of schizophrenia may be related to the impingement, through schizophrenic withdrawal, of insulin-stimulated hunger pangs and the satisfaction from the simple adaptive response of taking food. In any event, shock in and of itself does not cure the patient. It merely increases his chances for recovery. At best, it apparently weakens, or partially disintegrates, a pathologic pattern of functioning, which had become more or less fixed or frozen.

Psychotherapy for the schizophrenic patient is a delicate matter. While the pessimism of Freud [46] regarding the possibility of benefiting

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44. Myerson, A.: Theory and Principles of "Total Push" Method in Chronic Schizophrenia, Am. J. Psychiat. **95**:1197-1204, 1939.

45. Nielsen, J., and Thompson, G.: The Engrammes of Psychiatry, Springfield, Ill., Charles C Thomas, Publisher, 1947, pp. 240-242.

46. Freud, S.: On Narcissism, Collected Papers, London, Hogarth Press, 1946, vol. 4, p. 31.

the schizophrenic patient by psychotherapy is not shared by all his followers, it has long been recognized that attempts at psychotherapy, particularly attempts at psychoanalysis in the classic pattern, may sometimes precipitate a schizophrenic breakdown in a predisposed person. Such methods of exploring emotional dynamics commonly create a substantial emotional strain, which results in additional tensions and frustrations related to the therapeutic process. In the marginal person such frustration may be insupportable. This has been explained by saying that the schizoid person has a weak ego. This is another way of saying that he has only limited capacity to maintain motivated adaptive effort in the face of frustration.

When the recovery of the schizophrenic patient has progressed to the point of a fair frustration tolerance, and when a good rapport has been established, then a cautious examination with the patient of his major areas of frustration—directed toward consideration of means of avoiding such frustration—may be valuable indeed. It is commonly not so much the event as the meaning one attaches to the event that determines frustration.

It has been recognized that the discriminating function of the forebrain, and of the frontal lobes in particular, involves implicitly an inhibition of the forebrain on the thalamus and action structures. A great many reactions are postponed while the forebrain decides what the reaction should be. The organism may give an avoidance reaction to a noxious stimulus without waiting for forebrain planning, but reactions to social situations almost invariably have and require participation of the forebrain. The forebrain does not always arrive at decisions easily—occasionally there is indecision. Forebrain indecision in the face of strong pressures results in intrapsychic tension and in external and internal frustration.

If the members of the general staff of a military organization are in constant disagreements and indecision, the organization may do better to dismiss them and function without them. Such traits as anxious indecision and tensely self-conscious apprehensiveness about social adequacy may be reasonably ascribed to difficulties experienced by the forebrain in performing its discriminative and decisive functions. These are traits extremely common in preschizophrenic persons, and are traits which undoubtedly play a role in determining schizoid withdrawal. They are typically diminished or lost after frontal lobotomy.[47]

In instances of schizophrenia in which a major cause of current frustration is chronic forebrain indecision, or intrapsychic tension, one

47. Kolb, L. C.: An Evaluation of Lobotomy and Its Potentialities for Future Research in Psychiatry and the Basic Sciences, J. Nerv. & Ment. Dis. **110**:112-148, 1949.

might expect the patient to be benefited by a lobotomy or leukotomy procedure, provided this were followed by adequate rehabilitative measures. The objective of such a procedure might be likened to converting a complicated machine which does not function at the complicated level for which it was designed into a simpler machine capable of functioning at a simpler level, by disconnecting certain parts.

The central hypothesis of this paper suggests a further possible method of treatment which seems worthy of investigation. This is the beginning reestablishment of flexible adaptive motivation behavior by a process of retraining which might utilize simple technics developed in learning studies with animals. Such technics have the advantage of simplicity and clarity. They are easily graded to the capacity of the subject, so that frustration experiences can easily be minimized. If, for example, the patient is given doses of insulin sufficient to stimulate hunger, but insufficient to produce severe symptoms, and is then guided into the winning of extra food by problem solving, beginning with very simple problems but undertaking gradually those of increasing complexity so that the patient is kept both striving and succeeding, it would seem that the patient might be aided increasingly to marshal his frozen resources in adaptive behavior. It would be necessary to make a transition from tangible food reward to intangible social reward, but this might be a gradual transition with extensive overlapping.

If we are successful in drawing out the schizophrenic patient and motivating him to use his capacities in a highly simplified, logical, predictable and somewhat objectified situation of our own creation, the method has obvious and profound advantages over trying to treat him by following his distorted thinking into the labyrinthine bogs of his private meanings and morbidly twisted logic. It is needful to help the patient evolve a way of dealing with the frustrations determining his breakdown before his recovery can be complete. But we should not overlook the fact that schizophrenia is a disorganizing disorder and that the frustrations which determined the process are disorganizing frustrations. To the extent that it may be possible to strengthen the patient's capacity to deal with life by progressive exercises in a relatively uncomplicated area of life, to that extent it is possible to condition him and get him into training for his decisive struggle with the devils of his own frustration. In this struggle the process of gradual infiltration is decisive oftener than is frontal assault.

SUMMARY

The hypothesis is presented that the schizophrenic process is a replacement of adaptive behavior by frozen, stereotyped "frustration behavior." Such a process sets in when an individual's threshold of

frustration tolerance is passed. When the resulting maladaptive stereotyped behavior results in more frustration, the process is typically progressive. Such stereotyped unadaptive behavior, resulting from continued frustration, has been demonstrated in animals and is demonstrably reversible.

This hypothesis is adequate to explain a large number of facts relating to the development of schizophrenia. It is adequate to account for known facts relating to treatment and recovery in schizophrenia and suggests the possibility of certain direct and more effective treatment methods at the psychologic level.

DEATHS ASSOCIATED WITH ELECTRIC SHOCK THERAPY

Report of Three Cases

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THE PURPOSE of this paper is to place on record 3 deaths which occurred in association with electric shock therapy. No attempts will be made to review previously reported cases. All treatments were given on a standard Rahm machine constructed by a hospital technician. The details of treatment technic are specified in the discussion of each case.

REPORT OF CASES

CASE 1.—A white man aged 34, single, was admitted to the hospital on Feb. 1, 1949. His psychiatric illness was diagnosed by members of the hospital staff as catatonic schizophrenia. Mental symptoms had first been noticed by the family six weeks prior to his admission. At the time of admission he was out of contact, mute, refused food and postured. At times he became restless and excited for a few hours at a time. He was known to have had rheumatic fever at the age of 10 years, which left a residual mitral stenosis. In June 1948 he had cardiac decompensation, which was controlled with digitalis. At the time of his admission he was receiving a maintenance dose of digitalis, 1½ grains (0.097 Gm.) daily. His activity in his psychosis produced obvious signs of decompensation, and it was necessary to increase the dose of digitalis to 1½ grains three times a day.

The patient's physical condition would not ordinarily have been considered suitable for shock therapy. However, his inability to cooperate with routine therapy for patients with cardiac disease made it necessary to consider the possibility of using electric shocks for their sedative effect. Members of the family indicated their willingness to permit electric shock treatment despite the gravity of his physical condition. An electrocardiogram and careful clinical evaluation by a cardiologist confirmed the staff diagnosis of mitral stenosis, ventricular enlargement and severe myocardial damage. The cardiologist expressed the opinion that the gravity of the psychiatric condition warranted the use of electric shock, although the risk to life was great.

On March 14 the patient received his first electric shock. This was preceded by administration of 3 cc. of curare intravenously over a period of three minutes up to ninety seconds before treatment, with no untoward reaction to the curare. A major convulsion was produced with the machine for delivery of electric shocks set at 70 volts for 0.4 second. Immediately after the convulsion neostigmine methylsulfate was given intravenously and oxygen by mask. The patient was abnormally cyanotic for twenty minutes after treatment. With a similar technic, treatment was repeated on March 16, 18, 21 and 23, with notable improvement in the mental status. After each treatment cyanosis persisted for five to ten minutes.

On March 26 the patient was given his sixth treatment. After the injection of curare he became more cyanotic than usual, and respirations were embarrassed. He became rigid as soon as the current was applied and did not have the typical grand mal convulsion. His pulse and respirations were never resumed after application of the current, and prolonged attempts to revive him were unavailing.

Necropsy was not performed until nine and one-half hours post mortem. Detailed cytologic studies of nerve tissue were not made. The pathologic report (in part) was as follows: "A myocardial infarct involving the septum and right ventricle at the apex was observed. On gross and microscopic evidence this was thought to be approximately two weeks old." Death was the result of cardiac arrest.

Case 2.—A white man aged 54, married, was admitted to the hospital on May 17, 1949, with the picture of an agitated depression of two years' duration, for which there had been no previous psychiatric treatment. There was no evidence of a toxic or organic factor except for the electrocardiographic changes noted in the following report: "This record is borderline normal. In the absence of any positive history of disease of the coronary arteries or abnormal physical findings, these changes are not a contraindication to electric shock therapy." As the patient had been under medical observation and all routine tests had been completed satisfactorily, electric shock therapy was started on the day following his admission. Treatment was of the multiple stimulus type. The patient was one of a group given similar therapy for purposes of evaluation. After the intravenous injection of 2 cc. of curare, the machine was set at 70 volts for 0.4 second and a stimulus administered. Immediately after the initial convulsion, the stimulus was repeated. This was done four times. The first four treatments were given on consecutive days, and considerable improvement was noted psychiatrically. No unusual physical reaction was noted after the treatments. On May 23 the fifth treatment was given. After this treatment the patient seemed to make a normal recovery, and forty minutes later walked unassisted to his room on another floor of the hospital. His breakfast was brought to him, and as he stood to receive the meal he collapsed on his bed. He rapidly became dyspneic and cyanotic. The pulse and blood pressure were unobtainable. Death occurred forty-five minutes after electric shock. The clinical diagnosis was myocardial infarction.

Necropsy, performed five hours post mortem, revealed arteriosclerotic heart disease with sclerosis of the coronary vessels, complete occlusion of both coronary arteries in their proximal portions and advanced myocardial fibrosis. The coronary arteries were patent in their middle and distal portions. This condition was interpreted by the pathologist as "evidence of collateral circulation by anastomosis with branches from the aorta, such as occurs in gradual occlusion of the arteries. Death was the result of myocardial failure."

Case 3.—A married white woman aged 56 was admitted to the hospital on Aug. 5, 1949, immediately after an electric shock treatment given in another hospital. She had been treated with seven electric shocks at this hospital in 1944 for a depressive episode, and a remission had lasted four years. She relapsed in June 1949. Her symptoms included nausea, vomiting, photophobia and headaches. She seemed vague and preoccupied, and the clinical picture was quite different from that shown five years before. There was difficulty in concentration, and conversation was disjointed and irrelevant. Physical examination revealed moderate generalized arteriosclerosis and some emaciation. The results of neurologic examination and routine laboratory investigations, including an electrocardiographic study, were within normal limits. Electric shock treatments were repeated on August 8, 10 and 12. The setting for the four treatments was at 70 volts for 0.4 second. Curare

was not used. Treatment was then withheld because the clinical picture was that of an organic confusional state. During the next few days the patient became increasingly apathetic and lethargic. No evidence of an infectious process could be found. The blood count, the urea nitrogen of the blood, the urine and the temperature were normal. On August 18 lumbar puncture was performed. The only abnormality was an increase in spinal fluid pressure, up to 220 mm. of spinal fluid. Neurologic examination was repeated, and the reflexes were found to be generally hypoactive, as compared with the status on admission. Oppenheim's reflex was elicited bilaterally.

On the morning of August 19 the patient seemed to be in coma and could not be roused. The pulse and respirations were slowed, and the blood pressure was raised. There developed Cheyne-Stokes respiration, hyperactive deep reflexes and a Babinski sign bilaterally. The picture seemed to be that of increased intracranial pressure. Heart action ceased the evening of August 19, seven days after the last electric shock.

Necropsy, performed sixteen hours post mortem, revealed early bronchopneumonia. Changes in the brain were equivocal and must be interpreted in the light of the interval between death and necropsy. Degenerative ganglion cell changes were observed in the nuclei of the mesencephalon and pons, with petechial hemorrhages in the brain stem. The cause of death could not definitely be stated.

SUMMARY AND CONCLUSIONS

Three cases of death occurring in association with electric shock therapy are reported. The technic of treatment is given in each case. An autopsy was performed in each case. In the first case it was known prior to treatment that the patient had a serious cardiac condition. In the second case necropsy revealed a long-standing cardiac condition that had not been detected clinically. In the third case the organic situation was more obscure, but apparently an organic change in the brain preceded electric shock treatment. The exact relation of the electric shock treatments to the death of the patients is not clear, but it is reasonable to assume that in the first case death was precipitated by the treatment. The autopsies in these 3 cases did not shed any light on the question of the effect of electric shock on the human brain. Two of the 3 deaths were due to cardiovascular, rather than cerebral, complications, and in our experience it is believed that, in general, the cardiovascular system is more vulnerable to electric shock than the central nervous system. As a result of experience in these cases, additional examination and careful attention regarding the cardiac status of our patients have been a routine procedure prior to treatment. If there is any indication of cardiac involvement, the patient is examined before each treatment. This includes taking an electrocardiogram before each treatment, as well as the usual clinical examination. If this procedure is followed, we feel that serious complications of electric shock therapy may be further minimized.

Pennsylvania Hospital.

News and Comment

AMERICAN ELECTROENCEPHALOGRAPHIC SOCIETY

At the fourth annual meeting of the American Electroencephalographic Society, held at Atlantic City, N. J., on June 10 and 11, 1950, Robert S. Schwab, M.D., Boston, was elected president; James L. O'Leary, M.D., St. Louis, vice president; Mary A. Brazier, PH.D., Boston, treasurer, and John A. Abbott, M.D., Boston, secretary. Charles E. Henry, PH.D., Hartford, Conn., was elected to the council.

NEWLY ELECTED OFFICERS OF THE AMERICAN NEUROLOGICAL ASSOCIATION

At the Seventy-Fifth Annual Meeting of the American Neurological Association, held in Atlantic City, N. J., June 12-14, 1950, Dr. Wilder Penfield was elected president; Dr. S. Bernard Wortis, president elect; Dr. Roland P. Mackay, first vice president; Dr. Donald MacPherson, second vice president; Dr. H. Houston Merritt, secretary-treasurer, and Dr. Charles Rupp, assistant secretary.

THIRD ANNUAL MEETING OF THE NEUROSURGICAL SOCIETY OF AMERICA

The Neurosurgical Society of America will hold its third annual meeting at The Cloister, Sea Island, Ga., on September 14 to 16, 1950. The program will consist of panel discussions on "hydrocephalus" and "Herniated Lumbar Intervertebral Disk," a neuropathologic conference and a series of papers on original work by members.

Dr. Frank J. Otenasek, Baltimore, is president of the society, and Dr. C. D. Hawkes, 22 North Manassas Street, Memphis, Tenn., is secretary.

INSTITUTE OF NEUROSURGERY AND BRAIN RESEARCH, UNIVERSITY OF CHILE

The University of Chile has established the Institute of Neurosurgery and Brain Research. This institute will function on the locale of the present Institute of Neurosurgery, and its director will be Prof. Alfonso Asenje. Construction of a modern building, dedicated both to the clinical aspects and to experimental investigation, will soon begin. Special attention will be devoted to the development of neuroanatomy, neuropathology and neurophysiology. There will be special departments of neurology, psychiatry, neuro-ophthalmology and otology.

FREE AND PART-PAY PSYCHIATRIC CLINIC

The Piedmont Psychiatric Foundation, a nonprofit corporation which supports scientific, educational and charitable activities within the field of psychiatry, has arranged with the Piedmont Psychiatric Clinic to sponsor a free and part-pay outpatient psychiatric clinic for those who are not in a position to meet the cost of private psychiatric care. Beginning on July 5, 1950, and on each Wednesday afternoon thereafter, the entire physical and professional facilities of the Piedmont Psychiatric Clinic, located at 6254 Claremont Avenue, Oakland 18, Calif., will be available to any one, including children, regardless of inability to pay. Any such persons in need of psychiatric diagnosis and treatment should communicate with the Piedmont Psychiatric Clinic in person.

Abstracts from Current Literature

EDITED BY DR. BERNARD J. ALPERS

Anatomy and Embryology

INTERRELATIONSHIP OF THE STRIO-PALLIDUM AND THE THALAMUS IN THE MACAQUE MONKEY. P. GLEES, Brain **68**:331, 1945.

Glees, by means of electrolytic lesions, destroyed discrete portions of the striopallidum in the macaque monkey. The resulting degeneration was studied by the Marchi method. It was found that area 4 projects to the putamen and area 6 to the pallidum. The caudate nucleus and putamen send their fibers chiefly to the globus pallidus. The ansa lenticularis is formed by the internal division of the rostral part of the pallidum and sends fibers into the ventral anterior nucleus of the thalamus and the ventromedial nucleus of the hypothalamus. The external and internal divisions of the pallidum form the fasciculus lenticularis and the pallidosubthalamic fibers. The fasciculus lenticularis delivers efferent fibers from the pallidum into the lateral thalamic nucleus by way of Forel's field and the fasciculus thalamicus. Some of the fibers from Forel's field terminate in the mamillary body and hypothalamus, while others end in the region between the mamillary body and the subthalamic nucleus as far as the level of the interpeduncular nucleus. Glees concludes that these fiber pathways indicate a close relation of the striopallidum, the thalamus and the hypothalamus.

FORSTER, Philadelphia.

HUMAN FETAL BRAIN CELLS IN TISSUE CULTURES: THEIR IDENTIFICATION AND MOTILITY. MARY JANE HOGUE, J. Exper. Zool. **106**:85 (Oct.) 1947.

Hogue grew explants from the brains of human fetuses ranging from 27 to 185 mm. (crown-rump length) in special mediums—in hanging drop or in roller tube cultures. The oldest cultures were flourishing after one hundred and forty-three days, at which time the incubator broke down.

There is early differentiation of many fetal brain cells into their characteristic adult forms: oligodendrocytes, macrophages, granule cells, cells of Golgi type II, Purkinje cells and giant nerve cells. Oligodendrocytes are the first cells to migrate from cerebellar explants, and these are followed by macrophages, then granule cells and later by Golgi type II cells, Purkinje cells, giant nerve cells and many other types of nerve cells. The branched processes of the brain cells are constantly changing their shape and size, and they form a neuropil around the explanted tissues. Photomicrographs taken at intervals show that human fetal nerve cells migrate slowly and have a definite polarity. Purkinje cells migrate with two large dendrites directed anteriorly and an axon following posteriorly. In the Purkinje cells, in the giant nerve cells, and in a few other cells granules were distinctly seen. In many nerve cells a nucleus with one or more nuclei was visible. Some nerve cells had two or three nuclei, or even a bilobed nucleus.

The definite relation to the nerve cells which the oligodendroglia cells maintain may be symbiotic. Manipulation of the tissue cultures produces a quicker response in the nerve cells (contraction) than in fibroblasts, epithelial cells or muscle cells. Nerve cells do not often liquefy coagulated chicken plasma, even in old cultures.

Such a study of living brain cells by the tissue culture method shows the enormous variety of forms which these cells can assume and their manner of association with each other.

The discussion section includes a review of the literature dealing with mammalian brain cells in tissue cultures.

REID, New Brunswick, N. J.

DEVELOPMENT OF THE SHOULDER REGION OF THE TURTLE, CHRYSEMYS PICTA MARGINATA, WITH SPECIAL REFERENCE TO THE PRIMARY MUSCULATURE. WARREN F. WALKER JR., J. Morphol. **80**:195 (March) 1947.

Walker studied the development of the skeleton, muscles and nerves of the shoulder region in the turtle Chrysemys picta marginata by examination of embryos in section and by the wax reconstruction method, and by dissection of an adult.

The evidence supports Miller's and Detwiler's (1936) view that the segregation of the muscles plays a major role in the elaboration of the brachial plexus. However, the development of the girdle is also of great importance in determining the length of the divisions and cords of the turtle's plexus. Since the plexus itself is completely formed at a time when the muscles and girdle are just beginning to differentiate, it is believed that the concentration of the limb bud and the aggregation of the premuscular mesenchyme into dorsal and ventral layers are important factors.

The conservative nature of the nerve supply to the muscles is the logical result of the fact that the nerves reach the two premuscular masses before differentiation is initiated and the subsequent cleavage of these masses follows a regular pattern. Changes in innervation are briefly considered from an embryologic point of view.

REID, New Brunswick, N. J.

THE CEREBROSPINAL FLUID PATHWAYS (A CRITICAL NOTE). GEORGE B. HASSIN, J. Neuropath. & Exper. Neurol. **6**:172 (April) 1947.

Hassin presents his opinions on cerebrospinal fluid pathways. The recent work of Somberg (*J. Neuropath. & Exper. Neurol.* **6**:166 [April] 1947) is deeemed inadequate because of failure to perform microscopic examination after the injection of methylene blue into the subarachnoid space of human subjects.

Hassin concludes, on the basis of his previously reported studies and of others presented in the literature, that the cerebrospinal pathways along which the spinal fluid escapes to the periphery extend from the subarachnoid space over the spinal roots into the spinal ganglia, from which they emerge to follow the perineurial spaces of the postganglionic nerve.

Macroscopically, the spaces over and in the spinal ganglia are not demonstrable just as similar spaces in the central nervous system, such as the Virchow-Robin spaces, cannot be seen grossly but can be demonstrated microscopically under certain conditions.

Injection of methylene blue is not a suitable method of demonstrating pathways especially without careful supplementary microscopic observations.

GUTTMAN, Wilkes-Barre, Pa.

THE EPIPHYSIAL REGION: DORSAL SAC; EPIPHYSIAL AND DORSAL SAC CONCRETIONS. P. QUERCY, R. RIGALDIES, J. CARLES and D. QUERCY, Rev. neurol. **79**:401 (June) 1947.

The authors review previously reported observations on the prolongation of the suprapineal recess into the dorsal sac, which in its complete form extends over the pineal body and under the great cerebral vein, passes through the intersection

of the veins, as through a buttonhole, continues over the vein of Galen and terminates in anterior relation to the canal of Bichat in front of the trunk of the vein of Galen. It has many variations, of which they note the following: 1. The dorsal sac may be bound by a vascular pedicle to the confluence of the great cerebral veins. 2. The sac may have a diverticulum which travels over the vein of Galen into the vascular sheath of the anterior part of the canal of Bichat. 3. In 1 fetus the dorsal sac was observed to travel above the vein of Galen, whereas in 5 children it was seen to terminate either above or between the great cerebral veins without any tendency to pass over them. 4. In the cat and dog the great cerebral veins join early so that the vein of Galen lies above the pineal gland. The dorsal sac is entirely subvenous up to the straight sinus, to which it attaches. Coronal sections at this point demonstrate a mass at the juncture containing lacunas lined with ependyma, which constitute the origin of the sac, venous lacunas, arteries and several unmyelinated nerves. In the rat and rabbit, the sac and the pineal are both long, and there is no portion above the vein of Galen.

The authors review previous work showing that the calcareous deposits in the pineal body differ considerably from the calcification in arteries, viscera and other parts of the body. They find no connection between blood vessels and the calculi of the pineal gland, as previously reported. They point out the following facts concerning concretions in the pineal gland:

1. The largest concretions result from a confluence of small spherules, accounting for the mulberry-shaped, studded surface of the larger masses. 2. Concretions are found chiefly in the anterior part of the pineal gland and over the glial covering of the habenular commissure, which is often studded with them, while the posterior commissure has none. 3. The concretions vary greatly in incidence in different subjects. 4. They are usually related to precollagenous fibers of the gland. The concretions are in immediate relation to the reticular formation and possess a limiting membrane without surrounding connective tissue or glial reaction. A glial feltwork may surround the concretion, but the prolongations of the pineal cells are never in relation to them. Groupings of glial cells often seen within a gland do not contain the calculi. 5. In addition to concretions, one finds occasionally calcareous dust composed of calcified reticular fibers or glial processes. 6. In cross section the smaller concretions and the individual parts of the larger ones are seen to have an onion layer formation. Some are built up of calcified collagenous fibers in the form of a crude network.

Neighboring structures with calculi have only the small spheroid types with a regular surface and a single center of precipitation. Unlike the pineal calcification, they all show a black cross under polarized light. Decalcification and microdissection reveal a lamellated structure with no cells or nuclei. Refraction of polarized light persists after decalcification. All methods of study reveal that these calcifications are not connected with blood vessels or connective tissue fibers. Very few calcifications are found in the choroid plexus of the third ventricle or of the fourth or lateral ventricles. The principal site of the peripineal calcification is the dorsal surface of the dorsal sac, where they are rather restrictively located. Analysis of the calculi by chemical methods and by roentgen crystallography reveals that they are not composed of calcium phosphate and calcium carbonate, as previously thought, but rather of an apatite, analogous to that found in bone or in dentine structures.

LEGAULT, Washington, D. C.

Physiology and Biochemistry

THE OCCURRENCE OF DICHOLESTERYL ETHER IN THE SPINAL CORD OF THE OX (BOS TAURUS). H. SILBERMAN and S. SILBERMAN-MARTYNCEWA, J. Biol. Chem. **159**:603, 1945.

A search of the literature reveals that there is no record of the separation of dicholesteryl ether from natural sources. Silberman and Silberman-Martyncewa conclude that the quantity of the dicholesteryl ether isolated from the spinal cord amounts to 1.5 to 2 per cent of the weight of the dry source material.

PAGE, Cleveland.

EXPERIMENTAL STUDY OF THE NEUROGENIC RELATIONSHIP BETWEEN OPTIC AND ANTENNAL SENSORY AREAS IN THE BRAIN OF DROSOPHILA MELANOGASTER. MAXWELL E. POWER, J. Exper. Zool. **103**:429 (Dec.) 1946.

A series of seven classes of flies with eyes having reduced numbers of ommatidia was developed by using certain mutant strains of Drosophila melanogaster. A quantitative volumetric analysis of the antennal glomeruli (organized fibrous centers without cell bodies) was made in the flies of this series which had rudimentary eyes.

The general architecture of the antennal glomeruli is not disturbed by reduction, or even complete absence, of compound eyes. However, the volume of the antennal glomeruli is reduced linearly with the reduction in the size of the compound eyes. Complete absence of the eyes is associated with a hypoplasia of 27 per cent in the antennal glomeruli, and intermediate amounts of optic reduction are directly correlated with a comparable decrease in the antennal glomeruli.

Since generalized cerebral reduction does not occur, the hypoplasia of the antennal glomeruli may be the result of a more specific optic-antennal neurogenic relation. There appears to be a unilateral, rather than a bilateral, relation between optic and antennal centers, for the latter are significantly different on the two sides in those flies which have an eye on one side only. The antennal glomeruli on the blind side are volumetrically like those in completely blind flies, while those on the eyed side are as large as those in heterozygous Bar females.

These results appear to indicate that the genetic factors which regulate eye size affect the morphogenesis of the antennal glomeruli by a chain of events. Reduction in the number of ommatidia produces a hypoplasia in the optic glomeruli by decrease of the centripetal visual axons. The author suggests that the neurogenic effect is relayed from the optic to the antennal glomeruli of the same side by the reduced number of association fibers extending through the multiple neuronal links and synaptic units of the various optic tracts, association centers, the olfactorioglobaris and the broad root of the antennal glomeruli. The antennal glomeruli are deprived of a quantity of their developmental requirements and are unable to develop to the full extent.

REID, New Brunswick, N. J.

RELATION BETWEEN THE ELECTROENCEPHALOGRAM AND MUSCLE ACTION POTENTIALS IN CERTAIN CONVULSIVE STATES. G. D. DAWSON, J. Neurol., Neurosurg. & Psychiat. **9**:5 (Jan.) 1946.

Dawson made simultaneous recordings of the electroencephalogram and muscle action potentials in flexor and extensor muscle groups of the limbs in 2 subjects with severe and in 1 with mild myoclonic jerkings. All subjects showed some form of spike discharge, with or without a slow wave, in the interseizure periods. During seizures, the patients with severe myoclonic jerkings showed spike dis-

charges with a period of thirty to seventy-five milliseconds at a rate of 8 to 13 per second. An accurate correlation was found between the spike discharges in the electroencephalogram and the action potentials of the muscular jerkings in the severe form, and a less close one in the mild form. The muscle action potentials showed that recruitment and facilitation had a different time course of decay for the flexor and for the extensor muscles. Between the seizures, changes in the spinal reflex excitability could be demonstrated. The author concluded that the changes in the electroencephalogram were too widespread to indicate their place of origin in the central nervous system and that the exact role of both cerebral and spinal mechanisms in the production of myoclonic jerkings is still to be investigated.

N. MALAMUD, San Francisco.

COMPLETE AND PERMANENT ELIMINATION OF THE HYPOTHALAMIC THERMOGENIC MECHANISM WITHOUT AFFECTING THE ADEQUACY OF THE HEAT LOSS MECHANISM. J. REESE BLAIR and ALLEN D. KELLER, J. Neuropath. & Exper. Neurol. **5**:240 (July) 1946.

The ability of normal dogs and of dogs with hypothalamic lesions to tolerate hot and cold environments was calibrated by subjecting the animals to several tests of environmental temperatures for a standard eight hour interval. All observations were made with the animals under basal conditions (postabsorptive states). Constant observation during the tests was made possible by glass doors on the refrigerated boxes and incubators thermostatically controlled. Blair and Keller, who employed the 10 C. environmental test, state that it is more reliable than the regulation interval for the assay of heat maintenance powers. The latter method is frequently rendered inaccurate by muscular activity.

It was observed that of the dogs with intact hypothalamus long-haired dogs tolerated both cold and hot environments slightly more effectively than did the short-haired dogs. The animal's ability to prevent a fall in rectal temperature when it was subjected to ordinary or cool environmental temperatures was completely eliminated by any procedure that severed the caudal connections of the entire hypothalamic gray matter. If only a small amount of the caudal portion of this gray matter remained undisturbed, considerable of this ability was retained. Evidence was encountered which indicated that at the hypothalamic level there are separate neural elements for the shivering and nonshivering thermogenic functions.

Certain "ahypothalamic and midbrain" dogs retained sufficient heat loss–regulating ability to combat successfully an environmental temperature of 38 C. for an extended period. Accordingly, in these preparations, there was complete elimination of all heat maintenance powers with retention of an adequate regulation of heat loss.

On the other hand, the heat loss mechanism was greatly impaired in certain dogs which retained considerable heat maintenance ability by virtue of the intactness of the caudal extent of the hypothalamic gray matter. Several possible explanations for these results which seem neurologically paradoxic are projected.

GUTTMAN, Wilkes-Barre, Pa.

CANINE EPILEPSY CAUSED BY FLOUR BLEACHED WITH NITROGEN TRICHLORIDE: IV. HISTOPATHOLOGY. M. L. SILVER, J. Neuropath. & Exper. Neurol. **8**:441 (Oct.) 1949.

The etiologic relation of bleached flour to the convulsive disorder in dogs (canine epilepsy) was demonstrated by Mellanby. Recent investigations have traced the toxic factor to a product of reaction between the flour protein and the

widely used commercial bleaching agent nitrogen trichloride. The electroencephalograms of animals with canine epilepsy produced by a bleached flour diet have been shown to resemble patterns seen in persons with idiopathic epilepsy.

Silver found that dogs fed a nutritionally adequate diet with 50 or 75 per cent of flour bleached by nitrogen trichloride as used commercially (agene®) exhibited ataxia and irregular convulsions which might lead to status epilepticus. There was also terminal loss of ability to concentrate urine.

Histologic studies revealed cerebellar degeneration, as evidenced by chromatolysis and loss of neurons in the Purkinje layer of the cerebellum, the dentate nucleus and some of the motor nuclei of the brain stem, without significant glial reaction. Increased fatty degeneration of kidney tubules was seen.

ALPERS, Philadelphia.

PERIPHERAL ACTION OF CLOSTRIDIUM BOTULINUM TOXIN. N. AMBACHE, J. Physiol. **108**:127, 1949.

The local effects produced by the intraocular injection of Clostridium botulinum type A toxin were studied in rabbits. In appropriate doses the toxin produces total paralysis of the cholinergic nerve fibers to the sphincter pupillae, which fails to react to light or to stimulation of the oculomotor nerve fibers. At this stage the muscle fibers in the sphincter still respond to acetylcholine in small doses. The adrenergic fibers within the eye are relatively unaffected by the toxin, and stimulation of the cervical sympathetic nerve fibers dilates the pupil as usual. The function of the sensory nerve fibers in the cornea appears to be intact, and if the toxin is injected into the anterior chamber of the eye reflex blinking and retraction of the eyeball can still be elicited by mechanical or electrical stimulation of the cornea.

There is evidence that the toxin can escape into the general circulation from the anterior chamber and produce lesions in the lungs. When it is injected subconjunctivally or when it leaks out from the vitreous body, the toxin produces additional local effects on the extrinsic muscles of the eye. These include paralysis of the musculus retractor bulbi, which results in proptosis and loss of nictitation.

The superior rectus muscle was chosen for analysis of the toxic effect on voluntary muscles. The "paralyzed" muscle does not respond to stimulation of oculomotor nerve fibers but still contracts on intracarotid injections of acetylcholine. These results were confirmed on the tibialis anticus of the cat. After local injections of toxin, the muscle was completely paralyzed to stimulation of its motor nerve but responded to close arterial injections of acetylcholine. These and other findings suggest that botulinum toxin exerts its paralytic action by means of a selective peripheral effect on the cholinergic nerve endings.

THOMAS, Philadelphia.

METABOLIC CONSEQUENCES OF SPINAL CORDECTOMY. IRVING S. COOPER, COLLIN S. MACCARTHY, EDWARD H. RYNEARSON and WARREN A. BENNETT, Proc. Staff Meet., Mayo Clin. **24**:620 (Dec. 7) 1949.

Cooper and associates report the metabolic consequences of surgical removal of the thoracic, lumbar and sacral portions of the spinal cord of a human subject "in an attempt to halt the cephalad progression of an intramedullary glioma of the spinal cord." These consequences consisted of gynecomastia, decreased basal metabolic rate, hypoproteinemia with reversal of the albumin-globulin ratio, hep-

atomegaly and "demasculinization." The metabolic changes are similar to those previously reported in cases of trauma of the spinal cord but have not been recorded in radical operation on the spinal cord.

Derangement of protein metabolism following trauma is well known and is characterized by wasting of nitrogen, brought about by increased excretion of nitrogen, chiefly in the form of urea. "The actual mechanism of protein catabolism following trauma is not known."

Gynecomastia has been reported in many diseases, including traumatic paraplegia, Addison's disease, infectious hepatitis, malnutrition, tumor of the testis and chronic ulcerative colitis.

The demasculinization in the case of spinal chordectomy was characterized by atrophy of the testes and involution of the prostate. Similar changes have been recorded after traumatic paraplegia.

The pathogenesis of the metabolic changes in the case recorded is not known. Denervation of the endocrine glands by the operative procedures appears not to be a causal factor. Whether the changes observed are secondary to the effects of an alarm reaction is also not clear.

ALPERS, Philadelphia.

EXPERIMENTAL SYNDROME IN MAN OF SECTION OF THE SPLENIUM OF THE CORPUS CALLOSUM: PURE HEMIANOPIC VISUAL ALEXIA. PAOLO E. MASPES, Rev. neurol. **80**:100 (Feb.) 1948.

Maspes divided the corpus callosum in 6 cases. Four of the cases on casual observation presented no difficulty, but they were discarded for intensive study because of preexisting neurologic disorders. In the 2 cases reported there were no previous lesions of the hemispheres or postoperative neurologic residua, except for development of the syndrome of the cerebellar vermis in 1 case.

The first case was that of a 12 year old, right-handed child who, after the development of a syndrome characterized by intracranial hypertension, Argyll Robertson pupils, slight paresis of the sixth nerve and normal visual fields, had a papilloma of the third ventricle removed entirely without damage to the vein of Galen or to the internal occipital artery. She was examined intensively four years after the operation, and at the time of the report she did not have any neurologic signs.

The next case was that of a woman aged 44 who appeared with a syndrome of intracranial pressure, normal visual fields and disturbance in gait of cerebellar type. She was strongly right handed. The ventriculogram demonstrated a block of the aqueduct. The diagnosis of a pineal tumor was made, and by means of a flap formed in the right parieto-occipital region and an interhemispheric approach, the corpus callosum was incised in the region of the splenium. It was necessary to split the tentorium, and a piniksh, fleshy tumor was partially removed. The patient then received roentgen therapy. The veins of Galen were not damaged during the operation, and the occipital vein did not appear in the operative field. The postoperative course was uneventful, and a year and a half after operation the patient presented no symptoms except ataxia.

The author feels that these cases are ideal for study of callosal function because of the absence of damage to the hemispheres. Detailed testing of the visual functions included routine perimetric measurements, which revealed no deficit in the fields, even with reduction in light and size of target. Tests were performed for the following functions: (*a*) absolute orientation, the patient being asked to point out the position of targets in different fields; (*b*) relative orientation and judgment of the distance between two targets; (*c*) absolute appreciation of dimensions;

(*d*) relative appreciation of dimensions, through comparison of targets from different sides; (*e*) appreciation of movements of targets and the direction of their movements; (*f*) recognition of colors and appreciation of their intensities; (*g*) recognition of common objects, and (*h*) recognition of graphic symbols, letters, numbers and geometric designs. All tests gave normal results except the last, in which the patient demonstrated a clearcut, left homonymous alexia. The ability to perform this test had been checked previously on normal subjects, and it was found that between 30 and 40 degrees from center normal subjects recognized symbols as rapidly as with central vision. The subject gave a typical response that he could "see" the image of the symbol but that he did not "understand" it.

The author discusses in detail why his results differ from those of Akelaitis. He concludes that in the latter's study all the subjects had long-standing hemispheric difficulties and states, "The infantile cerebropathies generally show much more extensive damage anatomically than can be determined clinically and interfere in a very significant fashion with the development of the higher psychic centers; it seems therefore . . . that they lend themselves little to the study in question." The author also points out that the results of Trescher and Ford were similar to his.

He concludes that section of the posterior third of the corpus callosum causes interruption of the association fibers which in right-handed persons join the visual striated zone on the right with a superior representational reading center situated in the left hemisphere.

LEGAULT, Washington, D. C.

Neuropathology

ACUTE HEMORRHAGIC ENCEPHALITIS OF TUBERCULOUS ORIGIN. N. W. BROCKMAN and E. W. AMYES, Bull. Los Angeles Neurol. Soc. **14**:239 (Dec.) 1949.

Brockman and Amyes report the history and pathologic findings in a case of acute hemorrhagic encephalitis of tuberculous origin. After a short clinical course, the patient died in coma. At autopsy the white matter of the brain was found to be peppered with petechial hemorrhages. Histologically, perivascular hemorrhages, areas of infarction and small foci of necrosis and infection were seen. Brockman and Amyes assume that these lesions were due to lodgment in the cerebral vessels of multiple small emboli infected with tubercle bacilli.

ALPERS, Philadelphia.

IRON AND CALCIUM DEPOSITS IN THE BRAIN: THEIR PATHOLOGICAL SIGNIFICANCE. G. STRASSMANN, J. Neuropath. & Exper. Neurol. **8**:428 (Oct.) 1949.

Deposits of iron and/or calcium are found in the brain under a variety of conditions. Opinions differ as to their diagnostic and pathologic significance. For this reason, the brains of 280 mentally sick patients obtained at necropsy were investigated for the presence of iron and calcium, and the probable relation of these substances to special forms of psychosis was considered.

Males and females were equally represented, and patients over 60 years old constituted 66 per cent of the material under investigation. Brains from cases of acute and chronic psychoses of several types were studied. Each brain was examined with routine and special stains. The material was divided into three main groups: (1) brains with hematogenic iron (hemosiderin), (2) brains with autogenic iron (tissue iron) and (3) brains with calcium deposits. There was a frequent overlapping of groups, however, as a number of brains showed hematogenic and autogenic iron, as well as calcium.

The author found that probably not one but several factors cause an increased precipitation of iron and/or calcium compounds with or without combination of a hyaline matrix. Such deposits occur in a variety of psychoses at any age. In the higher age group they are commoner than in younger patients. An increase of iron and calcium deposits in special areas of the brain is only indicative of disturbances of an unspecific nature, of blood supply, of metabolic or of other disorders. It is not confined to one type of psychosis or mental disease.

ALPERS, Philadelphia.

FAMILIAL IDIOCY WITH SPONGY DEGENERATION OF THE NEURAXIS. L. VAN BOGAERT and I. BERTRAND, Acta neurol. et psychiat. Belg. **49**:572 (Aug.) 1949.

Van Bogaert and Bertrand describe 3 cases with the following clinical manifestations: (1) severe retardation of intellectual development, (2) hemiflexion, adduction and pronation of the arm and hyperextension of the lower limb, (3) rhythmic involuntary movements with tonic neck reflexes and decerebrate rigidity and (4) progressive atrophy of the temporal aspect of the optic disk without changes in the macula. This syndrome appears to be familial. Pathologic study revealed the spongy degeneration of the entire cerebrospinal axis with chronic edema of both the white and the gray areas of the brain.

DEJONG, Ann Arbor, Mich.

Psychiatry and Psychopathology

CLINICAL AND PATHOLOGICAL OBSERVATIONS ON RELAPSE AFTER SUCCESSFUL LEUCOTOMY. T. MCLARDY and D. L. DAVIES, J. Neurol., Neurosurg. & Psychiat. **12**:231 (Aug.) 1949.

McLardy and Davies report 6 cases in which the mental illness recurred after an apparently successful prefrontal leukotomy. The patients died for various reasons, not related to the operation, in periods ranging from one year nine months to four years two months after the leukotomy. In each case there was a relatively prolonged disappearance or striking amelioration of the psychotic symptoms. The illness, when it recurred, was practically always of the same type as that existing prior to operation. There were indications in some of the cases that environmental influences, both for good and for evil, may be augmented after the operation. Anatomic studies revealed in 4 cases evidence of practically complete bilateral isolation of the prefrontal cortex from its long fiber connections. Only the gyrus rectus and the posterior part of area 9 were consistently spared. It was apparent that an affective or a schizophrenic functional psychosis can recur after nearly complete isolation of the prefrontal cortex from its long fiber connections. This would signify that either the isolated cortex can in the course of time become reactivated through relays of subcortical U fibers or intracortical pathways, and redetermine abnormal behavior, or that the psychopathologic symptoms can develop anew without participation of the prefrontal regions. The former possibility is supported by the fact that degenerative changes in nerve cells do not occur in the cortex rostral to the lesions, so that they continue to derive stimuli from regions elsewhere than in the cut corticopetal projection and association fibers. This is further confirmed by the fact that the electroencephalographic recordings from the prefrontal regions return to a relatively normal pattern shortly after leukotomy. In the opinion of the authors, the localization of mental function in the prefrontal regions is too rigid a concept and should be replaced by more plastic concepts of cerebral function.

N. MALAMUD, San Francisco.

PSYCHIATRIC CHANGES ASSOCIATED WITH FRIEDREICH'S ATAXIA. D. L. DAVIES, J. Neurol., Neurosurg. & Psychiat. **12**:246 (Aug.) 1949.

Davies investigated 20 cases of Friedreich's ataxia (hereditary spinal sclerosis) and reports 4 of them in detail. In 15 of the total number electroencephalograms were made, in addition to the neuropsychiatric study. In 3 of these cases, with clinical epilepsy, the electroencephalographic records were grossly abnormal, in 3 mildly abnormal and in 9 within normal limits. The cases represented a wide variety of mental disturbances, varying from depressive and schizophrenic reactions to behavior disturbances and epileptic seizures. In the opinion of the author, there is no simple explanation for the genesis of the psychosis in Friedreich's ataxia. The nonspecific types of reactions suggested that some of them might be related to factors other than Friedreich's ataxia. Cases with behavior and rage reactions and abnormal electroencephalograms may be compared with cases of epilepsy.

N. MALAMUD, San Francisco.

Meninges and Blood Vessels

THE ANTERIOR INFERIOR CEREBELLAR ARTERY: ITS VARIATIONS, PONTINE DISTRIBUTION, AND SIGNIFICANCE IN THE SURGERY OF CEREBELLO-PONTINE ANGLE TUMOURS. W. J. ATKINSON, J. Neurol., Neurosurg. & Psychiat. **12**:137 (May) 1949.

Atkinson reports 7 cases of acoustic neuroma in which death followed operation as a result of occlusion of the anterior inferior cerebellar artery, either through mechanical clipping or through postoperative thrombosis. The resulting syndrome was related to infarction of the lateral tegmental region of the pons, an area supplied by this vessel. The clinical picture was characterized by autonomic signs in the form of increased pulse rate, respiration rate, blood pressure and temperature. The author reviews the anatomic distribution of this artery, showing that the areas of the brain stem supplied by it contains centers of autonomic control, as well as the fifth and sixth cranial nuclei. He points out the frequent variations in size of this artery, whose larger size can be suspected when the posterior inferior cerebellar artery is unusually small, under which condition the aforementioned complications are more likely to occur.

N. MALAMUD, San Francisco.

RAPID SERIAL ANGIOGRAPHY: PRELIMINARY REPORT. J. B. CURTIS, J. Neurol., Neurosurg. & Psychiat. **12**:167 (Aug.) 1949.

Curtis describes a method of rapid serial angiography by means of a new apparatus which is capable of taking 25 full size roentgenograms at intervals of one-half, two-thirds or one second. The author demonstrates this in 2 cases, 1 showing a normal angiogram and the other a small cavernous angioma. The normal angiogram demonstrated diodone (diethanolamine salt of 3,5-diiodo-4-oxo-1,4-pyridine acetic acid) within the internal carotid artery and the proximal portions of its branches within two-thirds second. Filling of the arterial tree was complete in one and one-third to two seconds. At two and two-thirds seconds the capillary bed showed filling and there was early filling in the inferior longitudinal sinus. The deep venous drainage showed filling before the superficial venous bed. At six and two-thirds seconds maximal venous drainage was demonstrated. Only a minimal amount of diodone was visible at the end of eleven and one-third seconds. In the case of the cavernous angioma, accumulation of the contrast

medium and the venous drainage were markedly delayed because the lesion involved the capillaries rather than the arteries. The author concludes that with a serial technic a clearer picture can be obtained of arterial filling and venous drainage than with the conventional arteriogram.

N. MALAMUD, San Francisco.

Diseases of the Brain

POST-VACCINATION ENCEPHALITIS: A PROBLEM IN DIFFERENTIAL DIAGNOSIS. ALBERT P. ROSEN and RUDOLPH A. JAWORSKI, Am. J. Dis. Child. **78**: 248 (Aug.) 1949.

Tetanus and encephalitis may follow vaccination. Because postvaccination encephalitis is rare in the United States, it is frequently not considered in the differential diagnosis. Rosen and Jaworski report a case which illustrates some of the difficulties which the clinician encounters.

JOHNS, Philadelphia.

RETINAL TUMOR ASSOCIATED WITH NEUROFIBROMATOSIS (VON RECKLINGHAUSEN'S DISEASE). FRITZ J. BLOCH, Arch. Ophth. **40**:433 (Oct.) 1948.

Bloch reports the case of a retinal tumor observed in association with neurofibromatosis. The ophthalmoscopic picture resembled that in tuberous sclerosis. Whether the two diseases are one is questionable, but a relationship was suggested as early as 1912, long before the retinal changes in either disease were known. Orzechowski and Novicki drew such a conclusion from their pathologic studies. Van der Hoeve, who studied the condition most extensively from the ophthalmologic viewpoint, expressed the belief that tuberous sclerosis is closely related to neurofibromatosis, von Hippel–Lindau angiomatosis and the Sturge-Weber syndrome. The common point in these syndromes is the combination of cutaneous lesions with a tendency to form tumors in the most varied parts of the body, including the eye. Tumor of the retina is extremely rare in cases of neurofibromatosis. Tumors of the uveal tract and tumors of the optic nerve are seen relatively frequently.

In the case reported, the fundus picture remained unchanged during nine years of observation.

SPAETH, Philadelphia.

INVASION OF THE OPTIC NERVE BY RETINOBLASTOMA. ALGERNON B. REESE, Arch. Ophth. **40**:553 (Nov.) 1948.

In 1931 Reese published the results of a microscopic study of the incidence of invasion of the optic nerve by retinoblastoma. The report was based on a series of 119 enucleated eyes containing retinoblastoma. In 53 per cent of the eyes the tumor had extended into the optic nerve beyond the lamina cribrosa. In 43 per cent the optic nerve was not severed at operation beyond the extension of the tumor, and therefore residual tumor had been left in the portion of the nerve remaining in the orbit. Thus, in 42 per cent of the cases recurrence in the orbit and a fatal termination were to be expected unless measures were directed against the residual tumor left in the nerve at the time of operation. The globes on which these statistics were based were enucleated between 1878 and 1929, a period of fifty-one years.

A similar study was made on 116 eyes enucleated between 1934 and 1947, a period of thirteen years. In this series, the tumor had extended into the optic nerve beyond the lamina cribrosa in 27 per cent and beyond the site where the

nerve was severed at operation in 8.5 per cent. Therefore, the tumor extended beyond the lamina cribrosa in 1 of 2 eyes in older series and in 1 of 4 eyes in the more recent series. Earlier recognition of the lesion, more accurate differential diagnosis and prompter enucleation must account for the lower incidence of invasion of the nerve in the more recent series.

The lower mortality figures of the present day, as compared with those of many years ago, also reflect the earlier diagnosis and the longer optic nerve stump obtained at the time of enucleation.

As Reese states, from time to time there have been advocates of the combined intracranial and orbital operation for retinoblastoma. The rationale of this operation is based on false premises. The main purpose of Reese's paper was to show that there is at present a much lower incidence of nerve extension. On the basis of Merriam's analysis of the results of autopsy performed in 15 cases of death from retinoblastoma, it appears that retinoblastoma more frequently proves fatal by distal metastases than it does by extension into the cranial cavity. From this, it can be seen that retinoblastoma is much more than a local disease which jeopardizes life only by extension to the cranial cavity via the optic nerve.

SPAETH, Philadelphia.

HEREDITARY PARKINSON'S DISEASE: STATISTICAL REVIEW OF 626 CASES OF PARKINSONISM. SPYROS SCARPALÉZOS, Rev. neurol. **80**:184 (March) 1948.

Scarpalézos reviewed all cases of parkinsonism occurring at the Salpêtrière and Bicêtre since 1922 and presents the following conclusions:

1. There are undoubtedly cases of heredofamilial parkinsonism. The onset is usually after the age of 50 and occurs more frequently in men than in women. In most such cases, the disease is transmitted in direct line, suggesting a dominant genotype rather than a recessive trait.

2. Besides these cases in which parkinsonism appears to be hereditary, there are cases in which a hereditary predisposition, in the form of weakness of the nervous system, seems to exist. This weakness would seem to be situated in the basal ganglia or the extrapyramidal system and predisposes to involvement of this system by various types of exogenous or endogenous agents. This concept is confirmed by observation in the same family of cases of parkinsonism from various causes.

3. Both these types are rare, and they cannot be distinguished from each other with certainty. In any case they represent but a small proportion of all cases of parkinsonism. In our statistics, which seem the most extensive to date, cases in which heredity seems to be a factor represent about 4 per cent.

4. It seems inexact, therefore, to state, as do some authors, that parkinsonism proper is a heredofamilial entity.

LEGAULT, Washington, D. C.

THE NEUROBRUCELLOSES. A. WERNER, Schweiz. Arch. f. Neurol. u. Psychiat. **63**:349, 1949.

Experience with 2 cases of meningoencephalitis apparently due to Brucella abortus prompted a review of the literature on the neurologic complications of brucellosis. Trigeminal and occipital neuralgias, as well as brachial, intercostal and sciatic neuralgias, are frequently mentioned in the reports. Even focal cerebral lesions have been attributed to brucellosis. It is, of course, impossible in many instances to exclude the possibility that the neurologic condition is coincidental. Brucella melitensis was identified in a reported case of subdural abscess with

compression of the spinal cord, and either Br. abortus or Br. melitensis has been demonstrated by culture of the spinal fluid in a number of cases of meningitis. Culture of these organisms, however, is generally difficult. Radiculitis is commoner than peripheral neuritis. Involvement of one or more cranial nerves, usually in combination with meningoencephalitis, has been described in a number of cases. Transient sensory and motor paralyses, which are often preceded by paresthesias, are common signs of cerebral involvement. In other cases, mental confusion, apathy, hallucinations and delusions dominate the clinical picture. Meningomyelitis and meningoencephalitis are the most frequent neurologic complications of brucellosis and usually appear late in the course of the disease. Pleocytosis, associated with an increased concentration of protein of the spinal fluid, appears to be characteristic.

The first of the author's patients, a woman aged 37, was ill for a year with polyarthritis before complaining of headache. The headache became severe, and the patient suffered with occipital neuralgia. Transient aphasia with numbness in the right side of the face was followed by attacks of numbness and weakness in the right arm. The spinal fluid, when first examined more than two years after the onset, contained 90 cells per cubic millimeter, mainly lymphocytes, and 200 mg. of total protein per hundred millimeters. Papilledema was observed at this time, and the patient experienced visual and auditory hallucinations. A positive agglutination for Br. abortus was obtained in the blood in a dilution of 1:1,280. The symptoms subsided under treatment with Br. abortus vaccine to the extent that the patient could return to work, although she subsequently experienced a second attack of transient aphasia.

A woman aged 61 contracted brucellosis. Although able to resume her occupation five months later, she did not fully recover until eight more months had elapsed. Nearly two years after the onset of brucellosis, she began to complain of headache, which was attributed at the time to hypertension. Neurologic examination two months later revealed paralysis of the right external rectus muscle and an ataxic gait. The spinal fluid, which was under a pressure of 290 mm. of water, contained 86 cells per cubic millimeter and 171 mg. of total protein per hundred millimeters. Although positive complement fixation reactions for Br. abortus were demonstrated in both the blood and the spinal fluid, agglutination tests for the organism yielded negative results. The symptoms rapidly subsided after daily subcutaneous injections of Br. abortus vaccine were instituted, but in less than three months mental confusion of increasing severity developed. Increasing drowsiness and paralysis of the left arm were subsequently noted. Treatment with vaccine was again followed by prompt improvement.

DANIELS, Denver.

Treatment; Neurosurgery

EFFECTS OF MYANESIN UPON THE CENTRAL NERVOUS SYSTEM. G. D. GAMMON and J. A. CHURCHILL, Am. J. M. Sc. **217**:143-148 (Feb.) 1949.

Gammon and Churchill used mephenesin (myanesin®) intravenously in a variety of pathologic conditions in an effort to determine its site of action and consequent therapeutic possibilities. The drug was injected rapidly in a 1 or 2 per cent solution, the dose reaching 1 Gm. With this dose the effect lasted from a few minutes to one hour. The maintenance dose was given as an infusion at the rate of about 1 mg. per kilogram of body weight per minute.

The tremor of paralysis agitans was abolished in 7 cases; choreoathetotic movements were suppressed in 4 cases, and senile tremor was greatly improved. In 1 case of tetanus the spasms were abolished. On the other hand, the intention

tremor of multiple sclerosis was increased, and organic facial hemispasm, fasciculations of amyotrophic lateral sclerosis and chorea (2 cases) were unaltered by the drug.

On the sensory side, tabetic and causalgic pains were relieved, but phantom limb pain (1 case) was unaffected. In 6 cases of true petit mal without general seizures the discharges were abolished by this agent. In contrast, convulsions with focal cortical abnormalities and petit mal associated with generalized seizures, supposedly the result of cortical damage (2 cases), were unaffected.

From these observations, the authors conclude that the action of mephenesin appears to be differentially selective for the cluster of subcortical nuclei which make up the basal ganglia, thalamus and brain stem. With increasing dose the conducting mechanisms of the spinal cord, both motor and sensory, are blocked, and cortical activity is depressed. Finally, a peripheral neuromuscular block eensues.

No untoward reactions were observed, but side effects included a subjective sense of warmth, relaxation and slight giddiness, nystagmus, slurred speech and loss of ocular convergence. The drug is being investigated further for its possible use in psychoses because of its effect on the thalamus.

MADOW, Philadelphia.

TREATMENT OF PNEUMOCOCCIC MENINGITIS WITH MASSIVE DOSES OF SYSTEMIC PENICILLIN. HARRY F. DOWLING, LEWIS. K. SWEET, JAY A. ROBINSON, WILLIAM W. ZELLERS, and HAROLD L. HIRSH, Am. J. M. Sc. **217**:149 (Feb.) 1949.

In an effort to avoid the irritative arachnoiditis of intrathecal administration of penicillin, the authors treated 21 patients with pneumococcic meningitis by injections of 1,000,000 units of penicillin intramuscularly every two hours. Only 3 of the patients received a single intrathecal injection of the drug; 13 patients received sulfonamides in addition. There were 8 deaths, or 38 per cent, as compared with a fatality rate of 62 per cent of 66 patients treated with smaller doses of penicillin given systemically and repeated intrathecal injections of penicillin. Small amounts of penicillin were present in the spinal fluid of all patients within sixty minutes after intramuscular injections were begun. After eight hours the spinal fluid concentrations were between 0.08 and 1.25 units per cubic centimeter.

Of the patients who recovered, the temperature dropped more rapidly and the duration of pleocytosis was shorter among those who received massive systemic doses than among those who were given repeated intrathecal injections. No untoward reactions to these massive doses were observed.

MADOW, Philadelphia.

TRIGEMINAL TRACTOTOMY: OBSERVATIONS ON FORTY-EIGHT CASES. W. B. HAMBY, B. M. SHINNERS and I. A. MARSH Arch. Surg. **57**:171 (July) 1948.

The authors report 48 cases of trigeminal medullary tractotomy, with a mortality of 16.8 per cent. The operation was done for trigeminal neuralgia in 35 cases, with a mortality rate of 5.7 per cent, and for intractable facial pain, caused by a malignant growth, in the remaining 13 cases, with a mortality of 46 per cent.

Follow-up studies of 28 patients operated on for trigeminal neuralgia revealed that only 10 patients were completely free from pain, 5 had occasional mild pain and 6 had paroxysms of moderately severe pain. In 7 additional patients, however, the recurrent pain was severe enough to require trigeminal rhizotomy. Nearly

one-half the patients on reexamination complained of mild trigeminal dysesthesias. In only 3 patients did the operation produce trigeminal analgesia and, in addition, analgesia of the auricular and retroauricular region and the ipsilateral half of the tongue, palate, tonsil and accessible parts of the pharynx. In other words, the sensory deficit extended into the domain of the seventh, ninth and tenth nerves. In more than one-half the patients, the analgesia remained incomplete, with residual areas of normal sensation near the lips and nose.

In one third of the patients, ataxia of the ipsilateral arm was present after operation. This was the more pronounced, the more rostral the tractotomy incision was placed. In order to avoid this complication, the authors suggested that the tractotomy incision be made below the level of the obex.

LIST, Grand Rapids, Mich.

TRANSPLANTATION OF THE SPINAL CORD FOR PARAPLEGIA SECONDARY TO POTT'S DISEASE OF THE SPINAL COLUMN. J. LOVE and H. ERB, Arch. Surg. **59**:409 (Sept.) 1949.

In some cases of Pott's disease (tuberculosis of the spine) paraplegia is produced by angulation and stretching of the spinal cord over a sharp bony kyphos, resulting in mechanical compression of the cord and impairment of its blood supply. In 3 such cases the authors successfully decompressed the cord in the following manner: By means of a laminectomy, extradural granulation tissue was removed. The cord was mobilized by extradural rhizotomy and then transplanted into a new bed after the sharp, kyphotic bony ridge had been removed. The outlook for functional recovery appears best if the operation is performed soon after the onset of paralysis. Postoperative spread of tuberculous infection can be prevented by streptomycin. A similar surgical procedure was of benefit in 2 other cases of compression of the cord due to severe nontuberculous kyphoscoliosis.

LIST, Grand Rapids, Mich.

LUMBAR SYMPATHECTOMY FOR ARTERIOSCLEROTIC GANGRENE. W. S. MCCUNE and W. EASTMAN, Arch. Surg. **59**: 1234 (Dec.) 1949.

Nineteen patients with impending or fully developed gangrene due to arteriosclerotic disease of the lower extremity were treated with lumbar sympathectomy, usually with resection of the second and third lumbar ganglia. The results were difficult to evaluate, but 73 per cent of the patients showed some improvement, consisting of healing of the necrotic lesions with minimal loss of tissue and with decreased pain. If a major amputation is necessary, preliminary sympathectomy will occasionally permit amputation below the knee, but in most instances sympathectomy will not prevent a supracondylar amputation.

LIST, Grand Rapids, Mich.

THE SUCCESSFUL TREATMENT OF AN OBSESSIVE COMPULSIVE NEUROSIS WITH NARCOSYNTHESIS FOLLOWED BY DAILY ELECTRO-SHOCKS. SELIG M. KORSON, J. Nerv. & Ment. Dis. **1**:37 (Jan.) 1949.

Korson states that the obsessive-compulsive neurosis derives from instinctual conflicts during the pregenital period, with the result that the drives and aggressions of the child are merged with bowel functions. He reports the case of a white man, aged 27, who was admitted to a state hospital at the age of 21 years. Attempts had been made to train him to toilet at 7 months, and he was subjected to strict discipline in regard to religious and sexual matters. In his second

year of college he attended a retreat, where he was regaled with the bugaboo of the sins of sex; shortly after this experience the obsessions began. In the hospital, he was obsessed with the thought that he might kill his mother or any other female; he felt the need to wash his hands almost continuously, and he exhibited generalized sexualization of almost all activity. He was treated with six metrazol® convulsions and with weekly amobarbital interviews for one year, during which he gained partial insight, with a concomitant 75 per cent decrease in his hand washing. He was then given daily electric shocks for thirteen days, after which he became acutely disoriented and agitated for five days. Two weeks later he believed that he was cured; he has been home on visit for ten months, at work as a chemist, and has had numerous social engagements with girls.

FARMER, Philadelphia.

THE CONSERVATIVE TREATMENT OF LUMBAR DISK LESIONS. E. J. CRISP, Proc. Roy. Soc. Med. **41**:261 (May) 1948.

Adequate conservative treatment results in recovery from the majority of lesions of lumbar disk, but rest in bed alone is not sufficient, according to Crisp. Inasmuch as protective spasm develops after injury to a lumbar disk, nature's method of splinting is employed to keep patients in the position of optimum comfort and healing by minimal movement at the site of the lesion. A plaster jacket is applied with the patient standing in the position of most comfort, with no effort made to correct the deformity. The plaster extends from the xiphoid process to the pubis, anteriorly, and from the inferior angles of the scapulas to the tip of the coccyx, posteriorly, being accurately molded to the pelvis and the lower ribs. To allow the patient to sit down, sufficient plaster is cut away at the groins. The patient must rest in bed until the pain is relieved, after which he is allowed to get up. The plaster should be worn upward of three months. Hyperextension exercises are given after the removal of the plaster. A lumbar brace is worn for a further three month period.

BERRY, Philadelphia.

RETINAL GLIOMA WITH SUCCESSFUL USE OF RADON SEEDS. E. F. KING, Proc. Roy. Soc. Med. **41**:267 (May) 1948.

In 2 children with retinal glioma the eye with the more extensive growth was enucleated and the other eye successfully treated by the application of radon seeds to the sclera over the growth. In 1 child visual acuity was 6/24 nine years later, and in the other child, 6/18 after five years. A sister of the second child had a unilateral glioma removed three years ago, with no sign of bilateral involvement.

BERRY, Philadelphia.

THE ROLE OF PHYSIOTHERAPY IN THE TREATMENT OF POLIOMYELITIS. F. S. COOKSEY, Proc. Roy. Soc. Med. **41**:395 (June) 1948.

Although physical therapy may prevent deformity and assist in recovery of function in cases of paralytic poliomyelitis it may assist also in localizing and destroying the virus by rest and heat. Significant paralysis occurs in less than a third of cases of poliomyelitis, and experience has shown that in the early stages the chances of a diagnostic error are at least as great as the risk of serious paralysis supervening.

Poliomyelitis is conveniently considered in three stages: 1. Inflammatory phase (from a few days to a few weeks). In the preparalytic stage there is evidence that physical activity increases the risk of paralysis. Complete rest is the most effective therapeutic agent in reducing the damage done by the virus. A firm bed, pillows and sandbags are sufficient to permit rest of most of the trunk and limb muscles, but exceptions, such as the biceps brachialis, the dorsiflexors of the hand and foot and the intrinsic hand muscles, require the use of light splints. The optimum position is one midway between contraction and relaxation. Until fever, pain and muscle tenderness have subsided, rest is of primary importance. Pain counteracts the beneficial effects of general and local rest and must be relieved. If moist heat fails to relieve pain, it is probable that the method of splinting is inadequate. Prophylactic movements (one full range movement once or twice a day) is necessary to prevent fixed shortening of muscles and edematous, stiff joints.

2. Stage of potential recovery (from few weeks to as long as two years). The first six months are all-important; there is a danger of doing too much at the beginning. Persistent and patient physical therapy is the keystone of treatment. The important procedure is frequent and carefully graduated exercises with intervals of effective rest. In addition, the coordination of muscle groups must be trained.

3. Stage of chronic disability. Sometime between six months and two years it becomes obvious that no further improvement in the weak muscles is likely to be obtained from graduated exercises. Beneficial trick movements are then encouraged, and as a compensatory measure surviving muscles are developed by intensive exercises.

In his discussion of the paper, Dr. P. Bauwens points out the value of electromyographic observation in cases of poliomyelitis. The onset of the disease is in many ways the development of motor neuron disease telescoped into a very short space of time. Fasciculations may be seen in the acute phase, and there is often evidence of hyperirritability of the muscles. As a result of the destruction of anterior horn cells, there is a decrease in the number of motor units operating in muscular contraction, and fewer potentials are recorded. In severe cases a repetition of discrete diphasic potentials on maximal contraction are noted from motor units which are still active without interference. When profound damage occurs to the anterior horns, their cells tend to fire off simultaneously instead of at random, and there is synchronization of motor unit activity. This sign of paralysis of medullary origin has grave prognostic significance. On the other hand, from the early recovery of some muscles which at one time showed a high degree of denervation, Bauwens derives evidence to support the theory of a peripheral neuropathic aspect of the disease, as distinct from the purely myelopathic aspect. These motor units give rise to highly polyphasic discharges during the phase prior to recovery—a good prognostic sign when they occur in muscles previously silent except for fibrillary activity, which is diagnostic of axon degeneration.

BERRY, Philadelphia.

USE OF "TRIDIONE" IN PETIT MAL. F. C. HAWARD, Brit. M. J. **2**:315 (Aug. 6) 1949.

Haward made a study of the efficacy of trimethadione (tridione®) in 50 epileptic patients treated from October 1947 to October 1948. Some of the patients had petit mal and some petit mal with grand mal. Treatment consisted of administration of 1 capsule (0.03 Gm.) three times a day; if no benefit was derived from this dose, the amount was increased to 6 capsules daily. In most cases the dose was gradually reduced as the fits ceased or became much less frequent.

Cessation or reduction in frequency of attacks was noted in 28.5 per cent of the boys and improvement in 75 per cent of the girls; 80 per cent of the men showed improvement, and 3.7 per cent of the women had cessation of attacks and 50 per cent improvement. Improvement in behavior defect and mental capacity was observed in several patients.

There were no serious toxic effects in the series. Photophobia was the commonest side reaction but occurred only in adults. One patient had decrease in the white blood cell count below 4,000 per cubic millimeter, and 2 children had a morbilliform eruption, 1 of whom also had a severe attack of stomatitis.

Haward concluded from the study that the best results are obtained in children and that the drug is effective only in cases of petit mal.

ECHOLS, New Orleans.

RESULTS OF THYMECTOMY IN MYASTHENIA GRAVIS. GEOFFREY KEYNES, Brit. M. J. **2**:611 (Sept. 17) 1949.

Keynes presents an analysis of 155 cases of myasthenia gravis treated by thymectomy from February 1942 to July 1949. Excluded from the follow-up evaluation were 10 cases of postoperative deaths, 18 cases of tumors and 7 cases too recent to include. In 79 (65 per cent) of the remaining 120 cases there was a complete, or almost complete, remission of symptoms which could not be considered "spontaneous." In the last 119 cases there were 5 deaths (4.2 per cent). A study of the results of operation in this series suggests that the shorter the duration of the disease before operation, the better the results. Keynes concluded from this study that, although the treatment of myasthenia gravis by thymectomy is still "empiric," this method of therapy, with the help of neostigmine, has undoubtedly alleviated many sufferers with the disease.

ECHOLS, New Orleans.

Society Transactions

PHILADELPHIA NEUROLOGICAL SOCIETY

Rudolph Jaeger, M.D., Presiding
Regular Meeting, March 25, 1949

Hemiballism and Its Control by Ablation of the Motor Cortex. Dr. B. J. Alpers and Dr. Rudolph Jaeger.

Two cases of hemiballism are reported, in 1 of which the disease was severe and in the other moderately severe. Both cases were typical instances of hemiballism, presumably associated with destruction of the opposite corpus subthalamicum by thrombotic softening. Both patients had hypertensive vascular disease and cerebral arteriosclerosis, so that vascular thrombosis appeared the most likely cause. A mastectomy five years before admission in case 1 raises the possibility of metastatic carcinoma, though histologic diagnosis of the amputated breast was chronic cystic mastitis. In both cases the involuntary movements were decreased by submaximal doses of curare.

Ablation of the motor cortex produced complete paralysis of the affected side in case 1, with no return of power and no recurrence of the involuntary movements. In the other case ablation was followed by incomplete return of power of the limbs, with only slight recurrence of involuntary movement of the left foot.

DISCUSSION

Dr. Charles G. Rupp: Have Dr. Alpers and Dr. Jaeger any theories as to why removal of part of the motor cortex did not produce hemiparesis or hemiplegia? Is it because they deliberately removed only a certain part of the motor cortex? If so, what portion did they select for removal?

Dr. Earl Walker: I wish to ask Dr. Alpers and Dr. Jaeger whether they tried the effect of drugs on the hyperkinetic movements. I am particularly interested to know whether they used mephenesin (myanesin®), either intravenously or orally.

I am very much interested in these cases, particularly because in the second case paralysis did not follow the operation and yet there was relief of the involuntary movements. One sees it stated in the literature that to relieve such involuntary movements paralysis is essential. Obviously, this case disproves that.

I should like to ask, though, whether the motor cortex was removed, or whether it was area 6 which was excised. Did the authors examine the tissue removed? Usually, area 4 extends only 2 or 3 mm. in front of the central sulcus; hence if the ablation was done as illustrated, the cortex removed probably was not area 4 (the motor cortex proper), but area 6.

I had a somewhat similar case about a year ago, although the hemiballism was on the right side. In order to avoid an aphasia, which would follow a cortical incision, I thought the movements could be eliminated by sectioning the motor pathways at a lower level, and I chose the cerebral peduncle because I had had

experience in working at that level. I sectioned approximately the lateral two thirds to three quarters of the cerebral peduncle. The patient had complete relief from her hemiballism immediately after the operation, talked on the afternoon of the operation and the next day was able to get out of bed. She had some weakness of the right arm, which lasted approximately two weeks. Then she had a few twitchings of the right shoulder for several weeks, but now has only an occasional fine twitch of the fingers.

She was diabetic and went into diabetic coma about three months after the operation. Except for that episode, she has had no further difficulty.

DR. E. WALKENSTEIN (by invitation): I should like to know whether there were any associated evidences of mental deterioration in either patient.

DR. GEORGE D. GAMMON: My comment is directed toward a minor point in this presentation. If I understood Dr. Alpers correctly, he said that this condition was usually fatal. I know of 2 patients who have recovered spontaneously. I wrote Dr. Moersch for a reprint of his excellent article on this subject. He replied that after he had told the family of one of his patients that the patient would die, the man promptly recovered. We had a similar experience about three years ago. A man had characteristic hemiballistic movements and since then, for two years, he has had no recurrence.

DR. JAMES RYAN: Did the authors consider section of the pyramidal tracts in the cervical portion of the spinal cord as a method of relieving the hemiballism?

DR. B. J. ALPERS: I should like to comment on the point that Dr. Walker raised. More interesting than the hemiparesis that was produced was the fact that the second patient did not have any, or had very slight, return of the involuntary movements after the return of power. That is why I feel that the second patient is very likely to have a return of hemiballistic movements. On the other hand, in the last note that we have from this woman she stated that she has had practically complete return of power, with only very slight involuntary movements of the foot.

We did not try mephenesin in any of its forms, but we used curare in submaximal doses. In the first case I was a bit afraid to push the dose as high as 90 or 100 units.

I am ashamed to say we did not examine the tissues carefully for evidences of area 4 and area 6, but we can still do so.

DR. RUDOLPH JAEGER: The question was asked, Dr. Alpers, whether there was any associated mental disorder in these cases. I do not think there was.

DR. B. J. ALPERS: No, there was not.

DR. RUDOLPH JAEGER: There was a careful histologic analysis that I do not think Dr. Alpers knew about. There were many cells appearing to be from area 6 in the second case. That is why I chose the anterior edge of the motor convolution. Of course, we identified the various motor centers there by electrical stimulation before the section was made; I chose to approach from area 6 rather than from the side of the central sulcus, because of certain observations I have made in the past. I considered, of course, as does any surgeon, cutting the motor tracts in the cord, or at a lower level than the cortex; but, to my mind, no one has arrived at any practical results in section of the motor tracts in the spinal cord. A great deal of experimental work has been done, but nothing useful has come of it.

There was partial paralysis, Dr. Rupp, as a result of this cortical resection. The arm, I think, was weakened somewhat; the leg, perhaps a bit. I have a

feeling that the effects of operation on any of these myoclonic states are accompanied with a certain amount of paralysis.

Actions of Diphenhydramine (Benadryl®) and Tripelennamine (Pyribenzamine®) on Convulsive Disorders. Dr. John A. Churchill (by invitation) and Dr. George D. Gammon.

Diphenhydramine when given intravenously decreased wave and spike discharges in the electroencephalogram in cases of petit mal and when given orally reduced the incidence of attacks. The electroencephalographic abnormality in cases with focal discharges was increased. Tripelennamine increased the electrical abnormalities associated both with petit mal and with focal discharges, frequently precipitating major seizures.

Use of Diphenhydramine in Treatment of Paralysis Agitans. Dr. Matthew T. Moore.

Thirty-one patients with paralysis agitans were treated with diphenhydramine (benadryl®) for from three to nine months; 19 had the postencephalitic form and 10 the idiopathic, and 2 had arteriosclerosis. All had received previously one or more of the preparations usually used for this condition. Diphenhydramine was given alone and with various adjuncts. The results were evaluated by scoring objective and subjective changes.

Oral administration of diphenhydramine alone was less effective than the belladonna derivatives; intravenous administration of diphenhydramine reduced tremor and rigidity for three to six hours. With combined diphenhydramine and scopolamine or rabellon® (a tablet containing belladonna alkaloids), 16 patients were greatly improved, and 9 patients showed fair improvement. The group with no improvement included the 2 arteriosclerotic patients. Tremor was more resistant than rigidity to diphenhydramine. No serious side effects were observed. In 2 patients electromyograms indicated that intravenous administration of diphenhydramine hydrochloride (40 mg.) stopped the tremors more rapidly and for a longer period than did intravenous injection of scopolamine hydrobromide (0.6 mg.).

The study indicates that diphenhydramine in combination with belladonna derivatives controls paralysis agitans better than the latter preparations alone.

Antihistaminic or antiacetylcholine actions of the drugs could not account for the difference in effects noted. However, the drugs may react in opposite ways on the mechanisms responsible for petit mal attacks. Diphenhydramine may prove of value in the treatment of petit mal. These drugs may induce fits in persons subject to seizures and may be used in electroencephalographic activation.

DISCUSSION ON PAPERS BY DRS. CHURCHILL AND GAMMON AND DR. MOORE

Dr. Nathan Schlezinger: It is interesting to have brought forward the proposal of a new drug for the treatment of paralysis agitans, because the condition in general has remained relatively refractory to treatment. However, the result of any program of therapy must, as I believe Dr. Moore indicated, be judged with considerable caution.

I had occasion to work several years ago with a group of patients with this disease, using a synthetic drug in an effort to avoid the side effects of atropine, and of course discovered, as have most other workers, that the patients respond to the atmosphere of increased attention and care that goes with any investigative approach to the problem. I believe, as Dr. Moore indicated, that time will be a

great factor in evaluating the effectiveness of diphenhydramine treatment of paralysis agitans.

The use of that drug alone, if it were remarkably effective, would certainly have given other results than those reported. The drug alone, as I understand it —and I hope that Dr. Moore will make that clear—does not offer a replacement therapy for the belladonna derivatives. Rather, it is something to be used in addition to them. As long as that is true, we cannot feel that it will be a remarkable addition to the therapeutic armamentarium we now possess.

However, Dr. Gammon's report would lend slight support, and probably would indicate that use of the drug is justified in an effort to determine more definitely whether it will be helpful in the majority of patients.

DR. CHARLES RUPP: I should like to ask Dr. Moore what has been the maximum time that he has followed the patients who have been receiving diphenhydramine and whether there has been any decline in the therapeutic usefulness of the drug as time goes on. All of us at times have become rather enthusiastic about the efficacy of various drugs in the treatment of paralysis agitans and later have discovered that with time the drug tends to lose what one might call its charm.

In connection with Dr. Gammon's paper, I wonder whether there was any effect on consciousness and the higher intellectual functions. Was there a generalized cortical depression which might explain the decrease in the frequency of the petit mal seizures?

DR. RUDOLPH JAEGER: Dr. Schlezinger and Dr. Rupp have both mentioned the "charm" that might go with an experimental project in which patients are involved. That might have something to do with the results. We surgeons even have tried to treat paralysis agitans. Some of the patients say their condition has improved.

DR. NATHAN SCHLEZINGER: I want to ask Dr. Gammon regarding the use of tripelennamine as a replacement for diphenhydramine for the purpose of bringing out seizures. Would he say that this drug could be used orally to precipitate an alternation in the convulsion potential in the electroencephalogram?

DR. E. A. DENBO: Has Dr. Moore had experience with diphenhydramine in treatment of the extrapyramidal disorders other than the parkinsonian state?

DR. H. T. WYCIS: I was interested in Dr. Gammon's statement about the probable mechanism of the action of diphenhydramine, particularly on the thalamus. It was implied, of course, in Jasper's experiments that the action of this drug must be on the thalamus. It is true that Jasper did note spike and dome activity from the cat's cortex after stimulating the region of the massa intermedia. In human subjects with petit mal epilepsy, Dr. Spiegel and I have recorded potentials from the thalamus, and we found abnormal discharges from the thalamus; however, the maximum of these discharges is not necessarily in the region of the massa intermedia. According to our experience, the maximum may be found in more dorsal parts of the thalamus. However, that is only a minor detail, and the drug may have a reaction on the thalamus, as Dr. Gammon recorded.

DR. MATTHEW T. MOORE: I must confess that I too share the skepticism concerning new drugs introduced for the treatment of paralysis agitans. When I read Budnitz' original article, in which he claimed sustained improvement in arteriosclerotic patients with parkinsonism under treatment with diphenhydramine, I was dubious whether any drug could be 100 per cent effective in this disorder. This, together with the desire to find something superior to the solanaceous drugs in the treatment of paralysis agitans, prompted my study. Other drugs, such as

tripelennamine, phenindamine (thephorin®), diethazine hydrochoride (diparcol®) and mephenesin (tolserol) were also tested.

In reply to Dr. Denbo's question: I have used diphenhydramine orally, intravenously and intramuscularly, both alone and in conjunction with scopolamine in 2 cases of *athethose doublé*. There was little appreciable effect. I have had a more satisfactory result with *d*-tubocurarine hydrochloride in suspension.

Dr. Gammon's paper warrants more discussion, especially since he has given us information on the effect of diphenhydramine in petit mal and other convulsive states. I have used the drug in 2 cases of petit mal, with encouraging results. This drug may be a valuable therapeutic addition, since trimethadione (tridione®) frequently is unsatisfactory and there is often the danger of a blood dyscrasia, 2 deaths from aplastic anemia already having been reported in the literature.

Dr. George D. Gammon: I do not know that we have tried oral administration to activate the electroencephalogram. It seems like a possibility for investigation, particularly since the amount needed to produce convulsions in animals is one hundred times that used in man, whereas with metrazol® there is an overlap.

Something has been learned from the surgeons about the mechanism of these abnormal tremors and involuntary movements. There is still much to be learned. However, to me the importance of these drugs, beginning with mephenesin, lies, not so much in whether they will cure parkinsonism or petit mal, as in the fact that they affect selectively different sections of the nervous system. Thus, one may have some idea of how to plan a drug which will act on the part of the nervous system in which one is interested.

Effects of Bilateral Stellectomy on the Cerebral Circulation of Man. Dr. Henry A. Shenkin, Dr. Robert A. Groff, Dr. E. B. Spitz (by invitation) Dr. W. G. Scheuerman (by invitation) and Dr. F. Cabieses (by invitation).

The cerebral blood flow, cerebral metabolism and cerebrovascular resistance were determined by the nitrous oxide method of Kety and Schmidt before and after bilateral stellectomy in a series of 5 patients, 4 of whom had postencephalitic paralysis agitans. In 3 of the latter the cerebral blood flow before operation was below normal (37, 37, 39 cc. per hundred grams of brain per minute, respectively). The cerebrovascular resistance in these patients was likewise markedly increased, the average being 69 per cent in each instance. After bilateral stellectomy, cerebrovascular resistance in each of these 3 patients returned to normal, and the cerebral blood flow correspondingly increased, on an average of 53 per cent. The remaining patient with postencephalitic paralysis agitans had an initial blood flow of 71 cc. per hundred grams of brain per minute and a cerebrovascular resistance slightly lower than normal. Operation did not affect these cerebral circulatory functions. The fifth patient, with essential hypertensive vascular disease and hemiparesis due to a cerebral accident two years before the present studies, had a normal cerebral blood flow and a cerebrovascular resistance of 75 per cent greater than normal. After bilateral stellectomy, her cerebral blood flow increased by 8 per cent and her cerebrovascular resistance decreased to 50 per cent above normal. The cerebral oxygen consumption in all 5 patients increased after operation, the average increase being about 12 per cent.

In 4 of the 5 patients studied, bilateral stellectomy produced relaxation of the cerebral vessels. This would indicate a mechanism for the intrinsic control of the cerebral circulation in man which is active at least in the diseased states which we studied.

DISCUSSION

DR. H. T. WYCIS: Would Dr. Shenkin comment further on his technic? As to the use of nitrous oxide as the agent: Did the authors consider the solubility coefficient of this drug when it is used in studies of the cerebral blood flow? Did the patient who showed no change in cerebrovascular resistance have any evidence of arteriosclerosis?

DR. ROBERT GROFF: Dr. Shenkin has covered the subject thoroughly, and I have only to say that the importance of this communication lies in the observation that in cases of postencephalitic paralysis agitans the cerebrovascular resistance is decreased after bilateral cervical sympathectomy. It may be that if this procedure were performed early in the course of the illness it might conceivably alter favorably the progress of the disease.

DR. F. H. LEWEY: There is quite a literature from the 1920's on disturbances of the autonomic nervous system accompanying paralysis agitans. Disturbances of blood pressure and pulse or instability of the blood sugar are common and apparently appear comparatively early in the disease.

The patients in the group who were benefited have maintained a satisfactory degree of improvement. I have not as yet seen, and time is too short to come to any final conclusion concerning, the waning effects one encounters with the various solanaceous drugs.

DR. RUDOLPH JAEGER: It is important, as Dr. Shenkin has done, to determine whether the blood flow actually is increased to the brain with sympathectomy. That has been the question in the minds of most neurosurgeons. Does vasodilatation actually exist after sympathectomy? I think Dr. Shenkin's contribution is valuable; he has a method for determining the effect on the cerebrovascular flow. I was amazed that Dr. Gardner, after presenting his series of 30 cases of Parkinson's disease before the Section of Nervous and Mental Diseases of the American Medical Association in 1947, concluded that the operation was of no benefit.

DR. GEORGE D. GAMMON: I should like to ask Dr. Shenkin whether there is a difference between the effect of stellectomy and that of procaine block on the cerebral blood flow.

So far as I know, all persons with postencephalitic paralysis agitans got their infection not later than 1926; I believe, and hope, that no new early cases are to be found now.

DR. H. A. SHENKIN: I certainly do not wish to report from our limited experience that bilateral stellectomy is of benefit in the disease processes mentioned. Our chief interest has been in the physiology of the cerebral circulation; however, it may well be that the patients will be benefited by operation if the initial low cerebral blood flow can be increased.

Bilateral stellate nerve blocks have been performed at the University of Pennsylvania by Dr. M. H. Harmel, Dr. J. H. Hafkenschiel and Dr. S. S. Kety, and the effect on the cerebral blood flow has been measured. They concluded that this procedure had no real effect on the cerebral circulation. Of course, there are obvious differences between their studies and ours: 1. Their experiments were acute, and ours were chronic. 2. It is conceivable the drug procaine and the procedure of injection may have effects on the cerebral circulation which differ from sympathetic denervation. 3. A procaine block may not completely inhibit the sympathetic innervation of the cerebral blood vessels in every case. I think we

can guarantee complete interruption of the sympathetic pathways through the stellate ganglion by operation.

There is perhaps a difference in the effect of sympathetic denervation which depends on the level of the original flow. From the little evidence we have, it appears that the effects of stellectomy on an initially normal flow are not remarkable. On the other hand, an initial low flow can be increased notably by sympathetic denervation.

I trust there are no new cases of postencephalitic paralysis agitans developing, but perhaps this procedure will be of help in the early stages of the arteriosclerotic type of the disease and will be of help in checking the progress of the disease. I do not know how many are impressed with the effect of the sympathetic control of the cerebral circulation; I had had three or four remarkable experiences with persons who appeared moribund and returned to consciousness through the effect of a stellate ganglion block. In each instance, it was quite clear that the difficulty was embolism of a cerebral vessel with severe spasm of the collateral vessels of the brain. In my opinion, therefore, there can be no question that this mechanism is potentially active, and one can assume that perhaps in a more chronic form, and in a more limited way, it is active in cerebral arteriosclerosis. The operation is not a severe one, or one difficult to perform. I think we are fully justified in extending our observations until we are convinced that the procedure is of no benefit.

B. A. Hirschfield, M.D., *Presiding*

Regular Meeting, April 22, 1949

Clinical Experience with Mephenesin ("tolserol"; myanesin®) in Treatment of Hyperkinetic Disorders, with Special Reference to Postencephalitic Paralysis Agitans. DR. ROBERT P. JEUB (by invitation).

The use of mephenesin ("tolserol") in treatment of paralysis agitans and the results obtained by observers elsewhere were reviewed. Twenty-five patients were treated, 20 of whom had postencephalitic paralysis agitans. Suppositories, both rectal and vaginal, and intravenous injections of the 2 per cent solution were used occasionally, but all patients were maintained on oral medication for a minimum period of six months. Control studies were made with intermittent substitution of placebos. The daily dose never exceeded 5 Gm. The object was not to upset established regimens with solanaceous drugs but, rather, to supplement them. Therapeutic action appeared in five to fifteen minutes and lasted from twenty to eighty minutes.

Of 20 patients with postencephalitic paralysis agitans, 18 showed transitory benefit from administration of the elixir. In 2 of 3 patients the frequency of oculogyric crises was diminished, but mephenesin had no effect when given during a crisis. Better plasma levels were obtained when the drug was administered as the elixir than in the tablet form.

Mephenesin was given in cases of other, miscellaneous hyperkinetic disorders, such as familial tremor, status epilepticus, the "frozen shoulder" syndrome and the acute low back and cervical disk syndromes. Its specific relaxing and analgesic action is an effective means of differentiation of pain due to joint and muscle disease and to compression of nerve roots. Intravenous injection of 150 cc. of mephenesin (2 per cent solution) was particularly favorable in relieving the spasm due to ruptured cervical disk before myelographic studies.

Lissidiol, a mephenesin analog, was also used, in doses of 0.25 Gm. It is about four times as active as mephenesin when given orally, and its therapeutic effect

appears to be about twice as great. It seemed more effective in 1 case of familial tremor. No toxic effects were noted from lissidiol.® In 2 instances in which mephenesin was taken too frequently, the patients complained of weakness and lassitude. One complained of nausea, which was overcome by shifting to the elixir. No leukopenia was found during a six month period.

In summary, mephenesin appears to be a useful adjunct when combined with the solanaceous drugs in treatment of postencephalitic paralysis agitans and some other hyperkinetic disorders.

DISCUSSION

DR. MATTHEW T. MOORE: In treating patients with paralysis agitans, especially those with an advanced form of the disorder, one must recognize that one is treating a total human being, not merely tremor or rigidity, so that the attack not only must be one of medication, but also must include factors of diet, occupation and emotional adjustment.

My experience with mephenesin has been limited to 10 patients of a series of 25. With these patients the drug proved of little or no value. In only 1 patient did I find it effectual, and here it was given in conjunction with diphenhydramine (benadryl®) and scopolamine. In my experience I have found that diphenhydramine given in conjunction with solanaceous drugs has been the most satisfactory form of treatment of paralysis agitans tried thus far.

DR. SHERMAN F. GILPIN JR.: I am glad to hear that there is a difference between the tablet and the liquid form of this drug, because, so far as I am concerned, the tablets might as well be replaced by water. I have never seen any toxic symptoms from mephenesin, even in doses of 8 tablets (0.5 Gm. each). I hope the solution works better. In my experience, however, any chronic patient given strong enough a suggestion—and a new drug may serve as such—will do many things he could not do the week before.

DR. F. H. LEWEY: I have not yet seen any improvement in paralysis agitans with caramiphen hydrochloride (panparnit®) alone. However, it seems to be a good adjunct to scopolamine or atrophine.

DR. ROBERT P. JEUB: Dr. Moore observed weakness, nausea and vomiting in his patients. These effects can be avoided by reduction in the dose. There is no cumulative effect because the drug is conjugated and excreted too rapidly. I found the therapeutic effect lasting at the most up to a few hours, except in muscle spasm, which is a different story. In case of the "frozen shoulder" syndrome the effect may be permanent, but here the administration is intravenous. The effect is particularly favorable when the drug is given before cervical myelography in elderly patients.

Dr. Gilpin's observation on the poor response to the drug in tablet form is correct. In some cases this is due to poor absorption. Plasma levels are higher when the elixir is used. I believe that one may treat symptoms in many disorders in which one cannot attach the actual cause because it is not known. Patients with paralysis agitans ask repeatedly for the same medicine. After six months they can tell the difference between the drug and the placebo given by any route.

Thymectomy in Treatment of Myasthenia Gravis: Report of Three Cases.

DR. JOSEPH C. YASKIN, DR. HERBERT R. HAWTHORNE (by invitation), DR. ALFRED S. FROBESE (by invitation) and DR. ROBERT L. LEOPOLD (by invitation).

Although conservative management of myasthenia gravis is useful in the average case, certain hazards are associated with the use of prolonged symptomatic

medication, namely, tolerance to the drug and the unpleasant side effects of neostigmine and ephedrine. With the decreasing risk associated with thoracotomy, in general, and mediastinotomy, in particular, the literature was reviewed critically, and an attempt was made to reevaluate the role of thoracic surgery in the treatment of myasthenia gravis.

Three cases were presented. In the first there were a long postoperative course and satisfactory postoperative result. The patient had failed to respond to a medical course of treatment. In the second case the disease was of very short duration. The disease could not be controlled with medication but responded well to excision of a thymic mass. In the third case mediastinotomy was postponed twice, and while the patient was under observation a probable malignant tumor developed. The prognosis would probably have been better had the exploration been made earlier.

Conclusion.—From the study of the literature and from the authors' limited experience, it seems worth while to perform exploratory mediastinotomy in cases of myasthenia gravis, even in the absence of demonstrable roentgenographic masses. The unsatisfactory medical management of patients with myasthenia gravis, and the decreasing, and now minimal, risks of thoracic surgery were cited. In addition, there is probably danger that a malignant growth may develop while the patient is under medical management.

DISCUSSION

DR. HERBERT R. HAWTHORNE: As is well known, there has been considerable discussion in the past several years as to the value of surgery in cases of myasthenia. From the figures which have been coming in over the past eight years, there appears to be improvement after removal of thymic tissue in about 50 per cent of cases. It is hard to understand why in some cases (as our first) the removal of fatty tissue with little thymic tissue in it produces relief of symptoms.

DR. NATHAN S. SCHLEZINGER: I have been interested in myasthenia gravis for ten years. There has been a feeling that something more than the medical treatment is necessary in coping with a substantial number of patients with the disease. Nevertheless, one should consider carefully the criteria for operative intervention. The mortality rate reported in the literature reaches at least 10 per cent. Furthermore, one rarely finds any enlargement of the mediastinum; so one has to decide on operation in the absence of any roentgenographic evidence of the thymic tumor. Do the authors agree with certain statements in the literature that patients with actual thymic tumors do most poorly after operation?

I should like to register a note of caution. I have found that many patients with myasthenia gravis do well for as long as ten years on a conservative program combined with neostigmine and ephedrine medication. The follow-up period for operations is not yet as long.

Dr. HUGO MELLA (by invitation): I have been interested in this problem for some time. I reported 2 cases (*M. Clinics N. America* **7**:939 [Nov.] 1923). In the first case a tumor of the thymus had been found at autopsy in a case of death from myasthenia. Shortly after this a woman of about 23 came into the clinic with a definite myasthenic syndrome. We studied her thoroughly and found that there was a roentgenologic shadow in the region of the thymus. Roentgen therapy was instituted; the shadow disappeared, and the patient recovered from her myasthenic syndrome.

In the same clinic a number of other patients with myasthenia were studied and no shadows were found; however, the etiologic factors may differ.

DR. ALFRED S. FROBESE: I should like to emphasize how little morbidity accompanies the surgical treatment by modern methods. It can be stated that with the present better understanding of the physiology of respiration, the improved anesthetic technics resulting therefrom and the use of antibiotic drugs, thoracic complications, which are the cause of most of the morbidity and mortality following thoracic surgery, have declined to a minimum.

The morbidity of thymectomy is relative to postoperative pain. This varies in degrees, and some patients have no discomfort from the incision. In all instances this pain can be controlled with analgesic drugs or, occasionally, with intercostal nerve block.

I believe the morbidity and mortality figures are lower than those that appear in the literature. Many of these statistics were compiled from earlier experience with this condition. This statement is borne out by the Keynes series, in which he reported 9 deaths in his first 21 cases and only 2 deaths in his last 42 cases.

A Study of Meningiomas Occurring in a General Hospital. DR. HARVEY M. BARTLE JR.

Seventy-seven cases of proved meningioma which came to the neuropathologic laboratory of the Philadelphia General Hospital over a period of twenty-six years were reviewed, and comparisons were made between cases in which the diagnosis was established clinically and cases in which the condition was recognized only at autopsy.

Frazier and Alpers stated that meningeal fibroblastomas, by virtue of their slow growth, often give rise to few symptoms in the early, and even in the later, stages; thus, the diagnosis is often difficult. As Cushing suggested, success in diagnosis of meningioma probably depends mostly on the use of pneumoroentgenologic studies. There would appear to be no clearcut clinical syndrome of tumor in cases of meningioma, as in many cases the cardinal signs of tumor of the brain or spinal cord were absent. It was admitted that in a series such as the one reported, from a general hospital, many patients are not likely to receive the benefit of special study because they are admitted for other conditions, and often the involvement of the nervous system is thought to be a complication of the known disease process.

This series of cases indicated the necessity of considering the possibility of meningioma in patients in older age groups with indefinite or equivocal neurologic signs. In these older patients, the assessment and evaluation of symptoms may be misleading, as evidenced in cases in which partial diagnoses were accepted in lieu of composite or over-all diagnoses.

DISCUSSION

DR. HELENA RIGGS: I can speak only from the pathologic standpoint. It is amazing how easy it is to make the diagnosis from the gross specimen. The gross tumor is nearly always well circumscribed; yet the histologic picture varies widely unless the picture is typical. I know of nothing so difficult to diagnose as meningioma from the slide alone.

Meningiomas are potentially malignant because they tend to extend into the tissues along the perivascular spaces. We have recently made studies of the underlying portion of the brain in cases of even the more benign, encapsulated meningiomas and find that there are frequently tumor cells extending into the brain tissue along the perivascular spaces, a finding which Cushing suggested as

the reason for the recrudescence of the tumor, even when it has been largely removed.

DR. NATHAN S. SCHLEZINGER: It is hard completely to evaluate a paper which covers such a broad part of the field of neurology. I may have missed the statement of the age incidence, and I am particularly interested to know whether any of the meningiomas were found in children?

DR. HENRY SHENKIN: As a neurosurgeon, I am a bit appalled at all these meningiomas being found at autopsy. Could Dr. Bartle shed light on the diagnostic approach to these tumors? Why it is that so many of them come into the autopsy room and so few to the operating room?

DR. HARVEY BARTLE JR.: The age range was from 1½ to 72 years, with the average age approximately 45 for the group with the diagnosed tumors and 52 for the group with the undiagnosed tumors.

In answer to Dr. Shenkin's question: Many of these patients were not studied properly from a neurologic standpoint. They were brought in for other conditions, and the tumor was an incidental finding. In some cases, of course, there were no clinical signs of involvement of the nervous system. In others, other symptoms covered those of the tumor, or there was no chance for study, since the patient died in a few days.

DR. HELENA RIGGS: Fully half the patients whose tumors were not diagnosed were from neuropsychiatric wards. A great many came in at an advanced age with acute hemiplegia, uremia or a cardiovascular disorder. We have recently been trying to evaluate the clinical symptoms as to the possibility of diagnosis of the tumor, knowing what we know from the autopsy. In most instances I do not think we could have made the diagnosis, and if we could the patient would have been dead before we could have got him to the operating room.

Pallidothalamotomy in Chorea. DR. ERNEST A. SPIEGEL and DR. HENRY T. WYCIS.

The efferent impulses innervating the abnormal involuntary movements in choreoathetosis are at least partly transmitted by the extrapyramidal system. If one wishes to interrupt this system in the subcortex instead of in the spinal cord, various locations may be considered, such as the substantia nigra and the globus pallidus. In view of the close proximity of the substantia nigra to the pyramidal tract, as well as to the important afferent systems, the globus pallidus seemed preferable. This ganglion can be reached by means of our stereotactic method in its anterior part by a puncture through the anterior limb of the internal capsule, so that the corticofugal system to the cranial nerves and the pyramidal system can be spared. We hesitated, however, to destroy the pallidum by electrocoagulation or electrolysis, because such a procedure may produce an obliteration of arterial branches passing through the pallidum to the internal capsule. Therefore, we attempted only to produce a slight, partial impairment of the function of the pallidum and injected 1 drop of 50 per cent alcohol into this ganglion. There was a second possibility of diminishing impulses leading to choreoathetotic movements. It is well known that emotions increase these involuntary movements. Since we had previously observed that lesions of the dorsomedial nuclei of the thalamus are able to diminish the emotional reactivity, and since, according to Papez, as well developed fiber system originating at least partly in these nuclei reaches the globus pallidus, it seemed worth while to produce also a lesion of the dorsomedial nuclei. A case of Huntington's chorea in a patient aged 53 was described in which a two stage operation was performed. In the first operation the injection of alcohol into the globus pallidus on the right was combined with

electrolytic lesions placed in the dorsomedial nucleus of the left side so that the effect of these two procedures could be compared. In the second stage, electrolytic lesions were placed only in the right dorsomedial nucleus in order to ascertain the effect of the thalamic lesion. Improvement was greatest in the hand opposite the thalamic lesion after each operation (moving picture demonstration).

DISCUSSION

DR. NATHAN S. SCHLEZINGER: We have all noticed patient's incessant speaking before operation and the apparent cessation of speech afterward. I wonder what that change represented.

DR. NATHAN T. MOORE: We are once again indebted to Dr. Wycis and Dr. Spiegel for their remarkable ingenuity in performing this procedure by means of their stereotactic device. We all recognize that Huntington's chorea is a progressive disease, and it is much too early to evaluate the net results with regard to the effect on the choreic movements. Unfortunately, the intellectual disintegration will continue despite the improvement gained with respect to the abnormal movements.

DR. HENRY T. WYCIS: In answer to Dr. Schlezinger's question: I think the film may have been misleading, for I believe that at the time of the first picture I was talking to the patient and I had forgotten to talk to him the second time. There was no aphasia in this case.

DR. ERNEST A. SPIEGEL: With regard to Dr. Moore's comments: It is well known that in chorea the cortex is finally involved; we did not intend to try to interfere with the disease process in the cortex. Rather, this study was an attempt to see what could be done in a progressive condition by placing lesions in parts of the extrapyramidal system or in the thalamus. We wanted to show that by acting on these ganglia, without injury to the pyramidal system and without producing undesirable by-effects, one can to a certain extent reduce the flow of impulses that innervate these involuntary movements.

PHILADELPHIA PSYCHIATRIC SOCIETY

Robert S. Bookhammer, M.D., President in the Chair
Regular Meeting, May 13, 1949

The Schizophrenic Reaction in Women Following Pregnancy and in Nulliparous Women. DR. A. STEPHEN TERZIAN.

A comparative study was made of 10 patients with schizophrenia following pregnancy and 10 nulliparous women with the disease. The author found that there was no psychotic reaction peculiar to childbirth. When a schizophrenic reaction occurred after childbirth, it was thought that the prognosis was good. The author has found it to be poor. Whereas others have stressed melancholia, he found the melancholia to be in reality a withdrawal which preceded the actual schizophrenic reaction.

For the psychoses precipitated by pregnancy, the average age was lower, the onset more sudden and recurrence at short intervals more frequent. Not a single patient in either group had an adequate sexual adjustment, and in the group with schizophrenia following pregnancy hypersexuality was a prominent symptom.

Nine of the 10 patients became ill after the birth of their first child, contrary to other reports. The diagnoses in the cases of psychoses associated with pregnancy were paranoid schizophrenia in 60 per cent and catatonia in 40 per cent,

whereas of the nulliparous group, 40 per cent had the paranoid type, 30 per cent simple schizophrenia, 20 per cent catatonia and 10 per cent hebephrenia. Both groups became worse without treatment. Therapy consisted on an average of fifty insulin comas and thirty electric convulsion treatments. The condition of 8 of the postpartum group remained the same or was worse. Six of the nulliparous group showed considerable improvement, and 4, showed fair improvement. Why do woman with psychoses following pregnancy fare less well than nulliparous woman with psychoses? This question still remains unanswered.

DISCUSSION

DR. HERBERT MARBACH: Dr. Terzian has called this "postpartum psychosis"; I prefer to call it "psychosis in the postpartum period." Smith and Smith, at Harvard, found toxic factors in the blood of pregnant women which, when injected into animals, produced so-called toxemias of pregnancy, such as were associated with psychoses in the last trimester of pregnancy. Although the women with normal blood counts were afebrile and often had normal blood pressures, they did show signs of toxemia. Women with psychoses which occur premenstrually and women with dysmenorrhea may be included with these patients. We feel that all patients with dysmenorrhea should be seen by a psychiatrist before being seen by a gynecologist.

Psychotherapy in Neurodermatitis. DR. RICHARD M. SILBERSTEIN.

The author first reviewed the literature available on psychiatric therapy for neurodermatitits and listed certain common personality traits on which all authors agree. The literature revealed that all these patients are very sick emotionally; when in danger of losing love, they retreat to narcissism and seek love through the abuse of the skin. Many of these patients suffer from accompanying psychosomatic illnesses and psychoneurotic disturbances.

A patient aged 28, who had had exacerbations of neurodermatitis since he was 3 or 4 years old, was then studied. His treatment was not completed, but sufficient material was elicited to reveal that he had gone through life repeating a stereotyped neurotic pattern, recreating situations which had occurred in his childhood. To him, his cutaneous condition was a method of expressing aggression which was otherwise forbidden and a method of gaining love. When his neurodermatitis was insufficient to satisfy these needs, bronchial asthma developed. The patient was clinically well at the time of the report but was subject to remissions and exacerbations. His freedom from clinical symptoms was dependent on his transference to the interviewer.

DISCUSSION

DR. HERMAN BEERMAN: In the last twenty years a veritable revolution has taken place in the attitude of dermatologists and others toward the problem of neurodermatitis. Recent studies have emphasized the role of psychic influences on so-called atopic eczema. For example, Cohen and Wolf, in their study of the automatic nervous system in atopic patients, noted increased palmar sweating in such persons. Woodhead was able to cure by psychotherapy a group of 26 children and young adults suffering from eczema, atopic dermatitis and papular urticaria which had resisted the usual forms of treatment. The skin was apparently utilized in these patients as a site for expressing strong unconscious conflicts relating to exhibitionistic tendencies and a frustrated desire for love and affection. There must be a simplification of the terminology used by the two types of specialists, and sweeping conclusions must not be made on the basis of a single case or small numbers of cases.

ROYAL SOCIETY OF MEDICINE, SECTION OF PSYCHIATRY

Sept. 12 and 13, 1949

SESSION I: RECENT TECHNICS IN PSYCHOSURGERY

J. R. Rees, M.D., London, Chairman

Topectomy. Dr. J. Lawrence Pool, New York.

The amount of tissue removed determines largely the outcome of the operation; it is necessary to remove 30 to 35 Gm. from each frontal lobe in cases of severe chronic psychoses and 20 to 25 Gm. in cases of depression or obsession, and 15 to 20 Gm. seems to be enough in cases of pain. More than this leads to profound personality changes.

Gross abnormalities are seen at operation in 50 per cent of the cases of psychosis. The cortex is yellow, firm and shrunken; the meninges are sometimes thick. No gross or histologic changes appear, however, in the removed specimens. The electroencephalogram is usually normal before and abnormal for six weeks after topectomy. Fourteen per cent of the patients have convulsions. Reoperations were necessary in 6 cases; the cortical leads were not abnormal in the cases without convulsions. There were no fatalities among the 125 cases. On stimulation of the anterior cingulate gyrus, there were sometimes respiratory arrest or acceleration and changes in the heart rate but no marked changes in blood pressure.

Of the patients operated on, the condition was judged to be improved in 44 per cent, somewhat improved in 24 per cent and unchanged in 32 per cent.

Cortical Undercutting. Dr. William B. Scoville, Hartford, Conn.

Cortical undercutting was performed in 106 cases: 90 of schizophrenia, mostly with deterioration; 11 of obsessive neurosis and 5 of pain. In 47 per cent of cases of undercutting in areas 9 and 10 and in 52 per cent of cases of orbital undercutting the condition was improved, whereas in only 21 per cent did improvement follow medial cuts which involved also the cingulate gyrus. Undercutting produces less disturbance in behavior and, theoretically, leaves the blood supply intact. There is no blunting as the result of operations on the convexity and moderate blunting from operations in the orbital region. Seizures occurred in 12 per cent of the cases. There were 2 deaths from hemorrhage. It is unlikely that there is any specificity of function in the frontal lobes. The results were satisfactory in 80 per cent of the so-called favorable cases.

Transorbital Lobotomy. Dr. Walter Freeman, Washington, D. C.

Transorbital lobotomy is swift, safe and effective and can be carried out by the psychiatrist himself. It has been found possible to sever the thalamofrontal pathways more completely by the deep frontal cut. This is performed as follows: With the instrument at the 7 cm. depth, and with the handle directed 30 degrees outward, the handle is elevated as much as possible to bring the shaft close to the orbital plate. The handle is then moved into the parasagittal plane, so that the orbital areas are undercut. The operation yields results that are almost equal to those obtained by the major operations. A moving picture showed the various aspects of the procedure.

Thalamotomy. Dr. Henry T. Wycis, Philadelphia.

A film was shown illustrating the application of a modified Horsley-Clarke apparatus to the human head, the zero reference point being the pineal body, or, if this is not calcified, the third ventricle, as seen in air pictures. Lesions were made by electrocoagulation in the dorsal medial nucleus of the thalamus; these covered an area 15 cu. mm. on each side and were verified by injection of a small quantity of iodized oil. Electroencephalographic tracings were taken during operation. Practically all these operations were performed on deteriorated schizophrenic patients, so that the results have not been of the best, but the features found after the usual lobotomy, such as inertia, masked facies, flattened speech, disorientation and incontinence, are common sequels. One fatality in 41 cases occurred through misplacement of the needles. In 6 cases the hypothalamus was attacked, once with success after thalamotomy had failed. In cases of pain, the instrument is directed toward the spinothalamic tract in the tectum of the midbrain, since thalamotomy itself fails to relieve intractable pain.

ABSTRACTS OF DISCUSSION

Mr. W. T. McKissock, London: Mr. McKissock had had an experience of 1,400 lobotomies, while 500 had been done by his assistants. During the past year he had tried to get away from the lateral approach of Freeman and Watts and restrict the lesions more. He stated preference for the Scoville method in cases of obsession and agitation and obtained results similar to those of other methods. He expressed the belief that Pool's operation impairs the blood supply of the neighboring areas and that Scoville does a purer job, but he cannot get results with either method in cases of schizophrenia. As to transorbital lobotomy, he stated: "Neurosurgical principles are gravely affected, and even more so if the operation is done by a psychiatrist." The essential defect seems to be that the frontal lobe moves laterally with the instrument, so that the surgeon may think that he has made a cut, whereas in actuality, and as proved at autopsy in 1 case, he has made only a puncture wound.

Mr. E. J. Radley Smith, London: The discussor described selective lobotomy, which he has performed since 1943. In some cases, the incision is horizontal, above the orbital plate, but oftener it is a low vertical incision. The blind method seems to be inaccurate, and the transorbital approach is inadequate. Sometimes, with a very small incision in a critical location within the frontal lobe, not more than 1 cm. in diameter, excellent results are obtained.

Mr. Harvey Jackson, London: "In performance of a leukotomy, the outstanding principle is to do as little as possible, but as much as necessary." Some of the excited states observed after leukotomy may be epileptic equivalents.

Mr. Hartman, Sheffield: Accuracy is important in leukotomy, for mistakes cause deterioration. Removal of areas 9 and 10 is not the answer because of distractibilit,y and in most cases the hallucinations continue. Removal of the cingulate gyrus, however, gives remarkable improvement in cases of early schizophrenia and manic-depressive psychosis by reducing the tension.

Mr. Knight, London: Anterior incisions are better, since they give rise to less blunting. Undercutting is the most rational procedure. These small, rather partial, cuts are useful for relieving constant headache.

Dr. B. E. Hemphill, Bristol: Dr. Hemphill asked what happened to the 40 or 60 per cent of patients who did not recover. In his opinion, the chemical aspects of the disorder have not been given sufficient emphasis. The tests for the vegetative system are still to be worked out satisfactorily.

MR. T. MCLARDY, London: The speaker had a collection of 120 brains of patients who died after various types of leukotomy. He had previously emphasized the serious results of posterior incisions. He wished to verify what he had said about the brain in which transorbital lobotomy had been performed and only a puncture wound appeared on one side. He stated the belief that the anesthetic used might control the condition of the brain at the time of operation, since, pathologically, no changes like those described by the surgeon, of hardness, yellowness and shrinkage, could be visualized.

DR. E. CUNNINGHAM DAX, Coulsdon, Surrey: Dr. Dax agreed with Mr. Radley Smith that most satisfactory results come from restricted operations in critical areas, but he was not able to describe the location of the 1 cm. incision that would produce such results.

DR. J. LAWRENCE POOL, New York: In reoperations in 6 cases, Dr. Pool had found that the neighboring cortex was affected at a distance of 1.5 cm. from the original cut. He insisted that the operation on the cingulate gyrus caused severe changes in the autonomic nervous system and did not result in improvement, while distractibility, in his opinion, followed posterior incisions. In a number of instances the patients had got along better than ever before in their lives.

DR. WILLIAM B. SCOVILLE, Hartford, Conn.: The operation is largely a quantitative matter, and its extent should be guided by the condition of the patient, the maximum amount being removed in cases of schizophrenia. "The therapeutic result is good in any mild case" if the operation was necessary in the first place.

DR. WALTER FREEMAN, Washington, D. C.: Dr. Freeman defended transorbital lobotomy, saying that the fears of the surgeon were largely groundless, since there had been only 2 fatal hemorrhages in 350 cases. Furthermore, with the deep frontal cut, there was no question of missing a major portion of the thalamofrontal radiations. Of 15 patients later subjected to major lobotomy after transorbital lobotomy, only 3 improved, indicating that many patients should not have been operated on in the first place and that the transorbital lobotomy could accomplish about everything that could be achieved by the major operation.

SESSION II: CLINICAL ASPECTS OF PSYCHOSURGERY

Dr. W. Rees Thomas, London, Chairman

Theoretic and Clinical Considerations of Various Leukotomy Technics. DR. PAUL HOCH, New York.

The various types of leukotomy are in a sense specific, since operations elsewhere than on the frontal lobes are ineffective. Furthermore, no result was obtained by ligation of the veins leading from the frontal lobe to the longitudinal sinus. It is more doubtful whether operations on areas 9, 10 and 46 are specific, since here the effect seems to be quantitative rather than qualitative. Furthermore, the operation leaves the personality intact, while some of the specific frontal functions are reduced, such as constructiveness, planning and synthesis of intellectual and emotional life. The postoperative changes are much more evident in cases of pain. Apparently, in many instances other cortical areas than those extirpated can take over. After lobotomy there is no gross impairment of intelligence; planning is somewhat reduced, and there is reduced vivacity, alertness and evaluation of body sensations. Pain no longer intrudes. Narcosis with pentobarbital sodium has a peculiar disassociating effect, and the patient incorporates his sensory stimuli into the ego but does not acknowledge the importance of these stimuli.

Lobotomy seems to have an effect on secondary awareness of caring or not caring. This detachment from the ego is different from repression. It is the same with phobias. The attitude changes; the symptoms are present, but domination by the symptoms is gone, and the basic condition remains unchanged. Psychoanalysis after operation shows no structural dynamic changes. The ego defenses are lowered; self evaluation is reduced, blocking is gone and interpretations are less easily accepted—it is impossible to hypnotize a person who has had a lobotomy. Conflicts are not important. The feelings of failure are gone. In all this, deterioration is a barrier.

Intelligence tests are not sensitive enough to detect the change. There is a certain amount of inertia and apathy. Drive, sublimation and foresight are impaired. The gestalt is intact. The patients are fairly effective in their day to day living and usually have enough anxiety for socialization, but sublimation is reduced. Surgical treatment seems to be quantitative. Aggressive patients need a major operation. The type of operation matters little with well preserved patients. In cases of the deteriorated psychoses, accompanied with great violence, operation brings about a certain amount of administrative improvement, and some deteriorated patients improve after the less radical operations. This reopens the question whether the so-called deterioration is not merely disorganization and regression.

Transorbital lobotomy leads to no personality damage, but the rate of relapse is high. Topectomy and undercutting harm the personality less than does lobotomy. The translateral operation is best in aggressive, chronic patients and is palliative in most schizophrenic patients. The impact of hallucinations and delusions is reduced by lessening of the tension.

Theoretic and Clinical Considerations of Various Leukotomy Technics.
DR. WALTER FREEMAN, Washington, D. C.

Safety and effectiveness have both been achieved by various psychosurgical operations. Lobotomy is ineffective in the chronic deteriorated patient and should not be performed. Two other desiderata in psychosurgery are accuracy and availability. Topectomy and precision lobotomy, cortical undercutting and thalamotomy, when carried out by an experienced team, seem to meet the requirements of accuracy. Transorbital lobotomy brings psychosurgery within the field of the psychiatrist.

The research on topectomy has shown that most leukotomies are unnecessarily extensive, and attention to the orbital quadrants and to selective leukotomy is along this line. There is a grading in the social adjustment of the patient according to the location of the incision in relation to the sphenoidal ridge and the coronal suture.

There is also a rather remarkable quantitative relation between the location of the incisions and ego functioning. A pair of tests were developed by Miss Mary Frances Robinson, the first measuring the self-regarding span, and the second, the sensibility. These tests measure the reduction of preoccupation with the self and the recognition of the self in relation to the social environment. Leukotomy effects a specific reduction in the patient's feeling of self continuity. "From the clinical standpoint, the operation can be adapted to the needs of the patient. An inadequate operation is useless. A too extensive operation is crippling. Granted that the patient is not deteriorated beyond recall, in which case no operation should be performed, the leukotomy should be just sufficient to relieve the neurotic or psychotic preoccupation with the self without, at the same time, trespassing on those parts of the frontal lobe that are necessary for adequate reintegration."

Rehabilitation After Leukotomy. Dr. C. C. Burlingame, Hartford, Conn.

Patients are more malleable after operation. They differ from their psychotic and also from their prepsychotic selves. There are reduced affectivity and increased responsitivity to environment. Training should begin immediately. It is unwise to send the patient back to the family, to the place where conflict originally arose; some should never return home. Furthermore, it is bad to send the patient back to the hospital, where, all too easily, he is apt to sink into the rut of his former activity. Therefore, a separate program is desirable. The patients are rather disturbing to the convalescents, and, left with the psychotic patients, they perpetuate the mannerisms of the latter. Therefore, they are placed in a service by themselves, and every effort is made to stimulate them to greater socialization. They are motivated by privilege cards, as a means of determining their assimilability to society. Only 30 or 40 of these patients can be handled at a time. The Rorschach test is an important guide to the patient's ability to get on in a family. These patients are less aware of the amenities, but frequently they adjust in group activities, involving both sexes, particularly in the social hour. Guidance and drill in personal habits are first necessary. If they are left to themselves, they suffer from "loafers' delight." The need for responsibility is impressed on them. When they leave the Institute, they should have no "rest" period, but should get a job immediately. Avocational training suited to the patient's own environment must be sought out. Psychologic tests do not demonstrate any loss in intelligence. In fact, the intelligence is often above the psychotic level. Desocialization is often mistaken for deterioration. There seems to be no advantage of one operation over another so far as retraining is concerned.

ABSTRACTS OF DISCUSSION

Dr. Alfred Meyer, London: The talk about personality change being an undesirable change is quite erroneous. Personality change is essential to improvement. This has a quantitative basis rather than reference to any specific localization. However, the experiments have indicated that the gyrus cinguli is not important in personality functioning.

Mrs. Asenath Petrie, London: Psychologic tests were carried out on patients operated on by Mr. McKissock before operation and then three months and nine months afterward. These patients had mostly severe neuroses. There were still some striking changes after nine months. There was loss in verbal performance, in social attitudes, with decreased neuroticism and introversion; the patients went in for speed rather than for accuracy; there were a decrease of self blame, neglect of the past and a peculiar enjoyment of jokes with a sexual tinge. Distractability was increased, but there was less alteration after rostral leukotomy.

Mr. P. M. Tow, Wickford, Essex: Leukotomy is of value, since the deterioration balances the psychiatric improvement. The deterioration is more marked in the well preserved patient, especially in the case of pain, than in the psychotic patient.

Dr. Erwin Stengel, Chichester, Sussex: A study of 330 patients, treated by the standard operation, shows 10.9 per cent seizures. The proportion is somewhat higher for schizophrenic patients. The operations should be carried out only as a measure of desperation, but it must be said that the level of desperation varies with different physicians. I would appeal for more care in defining the indications for operation.

Dr. Paul Hoch, New York: Given a well preserved patient, after lobotomy the damage is in the highest performance, where tests are unavailing. Even the best patients lose their creative individuality and their drive.

DR. WALTER FREEMAN, Washington, D. C.: Most of the psychosurgical procedures have been too extensive. Selective leukotomy and rostral leukotomy are valuable. The superficial lesions that follow the open operation evidently lead to a higher incidence of convulsive seizures. The suction cautery is particularly uncertain, because of extension of the lesions, sometimes as much as 2 cm., beyond the surgical plane of section. This is possibly due to the tensile strength of the axons, which the cautery sucks up, as would a vacuum cleaner in a bathtub full of spaghetti.

DR. LOTHAR KALINOWSKY, New York: Considerable loss of memory is found after shock therapy, which is not present after lobotomy. However, insight is less after lobotomy and is preserved after shock treatment. It is noted that loss of memory after transorbital lobotomy is less than would be expected after the three to five shocks given as a preliminary to this operation. Shock treatment and lobotomy are, therefore, in a sense complementary.

DR. E. CUNNINGHAM DAX, Coulsdon, Surrey: There are both specific and nonspecific factors in lobotomy. Lower cuts have a lower incidence of convulsive seizures. Additional shock treatments after leukotomy may have an adverse effect. Dr. Dax "studied 50 cases, in which the response to shock was good and 50 in which it was bad, in relation to leukotomy, and concluded that the response to the various forms of shock treatment is of no prognostic value for leukotomy." Leukotomy changes the personality, a feature of great advantage, since it is not obtained with shock therapy. It is possible that the selective leukotomy may spare the association fibers, and it is obviously true that sections of various parts of the frontal lobes give differing results.

DR. ERWIN STRAUSS, London: Electronarcosis helps obsessional psychoses and early paranoid schizophrenia. Shock treatment has unfavorable results after lobotomy and has even resulted in a few deaths.

DR. T. MCLARDY, London: Anatomic investigations have shown that the psychosis may return, even after complete section, or even after bifrontal lobectomy. The response, on the whole, is better after lobotomy than before, both to electric shock and to insulin. Electric shock produces no histologic change.

DR. SPENCER PATTERSON, London: At first, it seemed that better results were obtained with intensive shock treatment, but this has not been borne out. Electronarcosis is effective sometimes when shock treatment and insulin are not. There are many failures, especially with the affective disorders.

SESSION III: THE SHOCK THERAPIES

Sir Henry Dale, London, Chairman

Relation of Leukotomy to the Shock Therapies. DR. LOTHAR KALINOWSKY, New York.

Except for the significant motor areas, there is no localization of function of the frontal lobes. Electric narcosis is worthless, but it may prepare the patient for other types of therapy. Even organic symptoms can sometimes be influenced favorably by shock therapy. In preparation for some of these operative procedures, it might be important to remove certain sets of symptoms. The deterioration after lobotomy is due significantly to the progress of schizophrenia, which is not influenced by lobotomy. Confusion due to shock therapy may not be essential. Different types of currents are unimportant. Convulsion and coma are essential.

The Physiologic Basis of Shock Therapy. Dr. E. Gellhorn, Minneapolis.

Evidence is presented that shock therapy acts primarily through central autonomic discharges and through its effect on the cerebral cortex. Previous investigations have indicated that functional mental diseases, particularly schizophrenia, involve autonomic disturbances, probably at the diencephalic level. In stress situations, schizophrenic patients show less responsiveness of the sympathetic centers than do controls. That the chief difference concerns higher autonomic centers is indicated by the fact that certain autonomic reactions proceed within normal limits in schizophrenic patients, whereas emotional stress acting at the hypothalamic level reveals a diminished sympathetic reactivity. In shock therapy there is a prolonged excitation of sympathetic centers, and with increasing clinical improvement the sympathetic responsiveness increases.

Experimental physiology clarifies to some degree the sequence of events in shock therapy. Shock therapy invariably involves in the experimental animal an excitation of the sympatheticoadrenal system, as indicated by hyperglycemia, contractions of the nictitating membrane, rise in blood pressure, sweat secretion and lymphocytopenia. Hypothalamic and/or medullary autonomic centers are in a state of heightened excitability for relatively long periods. The reflex effects of sciatic stimulation on blood pressure, pupillary dilatation, contraction of the nictitating membrane and sweating are increased on administration of metrazol®. These effects are independent of convulsive activity and secretion of epinephrine. Of particular interest is the observation that metrazol® increases significantly the reactivity of the hypothalamus. Two mechanisms seem to be involved. In the case of insulin hyperglycemia and barbiturate medication, hypothalamic reactivation is the result of disinhibition from cortical control, and in the case of metrazol® or electrically induced convulsions the direct excitation of these centers seems primarily involved. Direct or reflex activation of the hypothalamus is accompanied with excitation of the ipsilateral and contralateral cortex, occurring primarily via the dorsomedial nucleus of the thalamus. This "upward" discharge also occurs in the presence of reduced or abolished cortical excitability and may therefore be the result of hypothalamic excitation through cortical disinhibition. These hypothalamic-cortical changes may explain alteration in behavior patterns after successful treatment in clinical cases, as well as in experimental animals. Shock treatment, especially insulin coma, leads to restitution of previously inhibited conditioned reactions but does not alter the positively conditioned reflexes. The changes in conditioned reactions occur in normal and in adrenodemedullated rats. Hypothalamic-cortical discharges persist in spite of cervical sympathectomy and elimination of the adrenal glands and are apparently independent of the sympathetic "downward" discharge.

ABSTRACTS OF DISCUSSION

Mr. Willy Mayer-Gross, Dumfries, Scotland: In shock therapy it is necessary to obtain coma. The cortex must be put out of function in order that results may be obtained.

Dr. Derek Richter, Cardiff, Wales: During electric shock convulsions phosphocreatine in the circulating blood is reduced by 70 per cent in a few seconds, and no further convulsions can be obtained until acetylcholine rises. Ammonia and lactic acid are released during the convulsion and phospholipids are altered by a combination of shock and insulin.

Dr. H. Weil-Halherbe, Essex: "Amino acids terminate hypoglycemia coma by their adrenergic component. Epinephrine, in small doses, abolishes coma, causing a rise in blood sugar."

DR. DENIS HILL, London: Homeostasis is a conspicuous phenomenon during shock treatment. Even in normal patients there is slowing of the electroencephalographic activity before the blood sugar rises, in reaction to the primary fall due to intravenous injection of insulin. Schizophrenic patients show a delay and little response to this test. There seems to be a primary failure of cortical function in schizophrenia. The cortex inhibits the diencephalon, while the diencephalon stimulates the cortex. In schizophrenia, the cortex fails to respond.

SIR HENRY DALE, London: The question was asked whether the depression of the diencephalon is responsible for the abnormal cortical responses and whether, when the hypothalamus is stimulated, the sympathetic effects are greater than the parasympathetic effects. Sir Henry stated that effects might persist for thirty days after shock therapy.

PROF. F. L. GOLLA, Bristol: After a course of shock therapy there is an increase in cholesterol gonadotropins, but no primary disturbance in the hypothalamus. The improvement after electric shock is accompanied with loss of memory. The profound emotion apparently frees the hypothalamus from its domination by the cortex.

DR. H. T. WYCIS, Philadelphia: In some cases in which thalamotomy failed to relieve psychotic behavior, hypothalamic lesions were added. These lesions improved to some extent the behavior of the patients.

DR. E. GELLHORN, Minneapolis: Lesions in the posterior portion of the hypothalamus reduce reactivity, whereas those in the auterior portion increase it. Sympathetic responses, in general, tend to decrease with age.

SECTION IV: MISCELLANEOUS PAPERS

Prof. E. L. Golla, Bristol, Chairman

Nature of Processes in the Central Nervous System in the Psychoneuroses. DR. W. S. MCCULLOCH, Chicago.

The bridge between the soma and the psychic is the signal system. Whether mechanical, electrical or neural, the mechanism is set up to give the answer "true" or "false," "yes" or "no." In the case of man-made machines, the system of signals may be upset, and then one speaks of gremlins that defy the laws of energy, length and force. The impact in such energy systems is filtered to 1×10^{-7}. Here, the relation is between gremlins in the machine and demons in the human organism. Convulsions, tremors and repetitive ideas are examples of "demons." Causalgia is a particularly clear example of a feed-back "demon." There is a perversion of function in the reflex circuit. This barrage sends the blood to the interior of the mechanism, and the preservation of proper temperature in the affected limb is disturbed. Then the causalgic nerve responds to everything. It requires some injury of the nerve to prepare for this "cross talk," and the control, instead of damping the reaction, becomes excitatory. The wound is, as it were, an artificial synapse.

Quick pain is carried by fast-conducting fibers and slow pain by the small fibers. The fast-conducting fibers serve to control later augmentation, and, when these are put out of function, the slow fibers use other afferent pathways to suppress the secondary mechanism. In such a situation, the "demon" moves into the cord, and amputation then only substitutes a phantom. It is as though the "devil" moves upstairs and remembers. In states of causalgia, stimulation of the postcentral convolution will sometimes cause pain, whereas it does not do so ordinarily. In this

case, excision of the postcentral convulsion may relieve the pain. Lobotomy removes neither the sensation nor the response, but it relieves the distress. The last retreat of the "demon" is apparently near the thalamus. In such instances, it would seem that a small primary input in a regenerating system produces a maximum output. Causalgia suppresses all information, but substitutes its own stereotyped response for the normal one.

Psychoneurosis begins in psychic reverberations. It suppresses memories and learned reactions. All stimuli lead secondarily into reverberating circuits and dominate all others. The regenerative circuit passes its impulses into other circuits and produces maximal output. These "demons" can go outward and even destroy effector mechanisms. Various drugs that act on the autonomic nervous system have some effect on these "demons." Atropine, for instance, prevents the faintness of vegetative retreat. Neurotic persons are more sensitive to insulin, and fat neurotic persons in particular have excessive vagal excitation of the islands of Langerhans. In these cases, 60 per cent of the sugar consumed goes into fatty acids. It is futile, therefore, to feed these people and expect them to get well.

Causalgia reverses the sign of the feedback from the negative to the positive. Neuroses can be precipitated by repetitive stimuli, or sometimes by a single intense stimulus. Amnesia usually accompanies such incidents. The blast, for instance, may be unrecalled, and an attempt to look backward to the events that precipitated the neurosis may bring back tremendous anxiety. With barbiturates and nikethamide, either rest or excitation may be brought about, with occasionally reharmonization of memories. Mephenesin (myanesin®) reduces the anxiety by controlling the activity of the internuncial plexus, and withdrawal of mephenesin often precipitates anxiety. It acts to damp the reverberations. Of 119 patients, 79 recovered under such treatment, the internuncial activity being first quieted with mephenesin and the normal impact then reenforced.

Carbon dioxide raises the voltage of all axons and makes them indefatigable. It raises the threshold to a high degree. Inhalation of 15 per cent carbon dioxide prevents induced seizures but, on the other hand, augments those referable to the midbrain. Inhalation of 30 per cent carbon dioxide alters the background and gives equal opportunity to the normal and the abnormal circuits for dominating the final common paths. The carbon dioxide method has been particularly useful in cases of conversion hysteria, in which there is a period of amnesia. It works also with stutterers, although causalgia, anxiety and obsessive tension states are made worse after an inhalation of carbon dioxide. Usually the method is to give 30 per cent carbon dioxide in oxygen, for forty respirations, three times a week. Frequently the patients will later experience a sudden return of memory and great reduction in the hysterical symptoms.

The "demon" is a regenerative circuit that excites instead of quiets. It gives birth to other "demons." Similar gremlins are known to occur, even in computing machines, which can be shown to have ideas and retention. "Cross talk" and gain are increased by repetition, and then inadequate stimuli, with practice, become adequate to induce the maximum response.

Physiologic and Psychologic Results of Thalamotomy. Dr. E. Spiegel, Philadelphia.

Emotional states can be influenced by focal lesions of the thalamus. Forty-one psychotic patients were operated on by the modified Horsley-Clarke apparatus; in addition, 7 patients had hypothalamic punctures. Thirty-nine per cent of these patients have been discharged. The primary effects of operation were somnolence, disorientation, loss of memory and denial of operation, lasting about a week. The

operation affects the primitive state of consciousness on which memory depends, perhaps referable to the vicinity of the mamillary bodies. Monoparesis was noted in 3 patients, defective elevation of the eyeballs in 3 and hyperalgesia in 2. There was no objective sensory change. Incontinence was present in 30 per cent of patients. There was no laughing or crying. The sympathetic reactions showed a transitory increase. Occasionally, there was increase in weight; the bladder was sometimes spastic, and the glucose tolerance was increased at first. Hallucinations lost their emotional tinge, and there was reduction in fear, anxiety and tension. Obsessive-compulsive reactions diminished after several weeks. Transitory hostility and increased sexuality were noted at times. The operation does not eliminate the schizoid character. Little change was noted in responses to the Rorschach test, except reduced color shock. There was no change in intelligence. Five of the patients are working, and 11 are living at home, with a reduced working capacity.

Stimulation of the medial nucleus, with local anesthesia, produced a feeling of weakness, but no anxiety or excitement. Hypothalamic lesions, in patients who remained catatonic after lesions of the thalamus, produced a moderate reaction and reduced the catatonia. This reaction consisted of fever, polyuria, flushing of the skin and anisocoria. Distractibility and profanity were not observed. There were no changes in the electroencephalogram until a few days after operation, and these changes improved in a month. Only 1 patient had a convulsion. Sometimes, when the electrodes were close to the ependyma of the third ventricle, the waves were synchronous with the heart beat, possibly a mechanical effect. Direct leads from the hypothalamus had a different rhythm from those obtained from the pharynx. The latter were probably picking up temporal waves. Electric shock produced dysrhythmia in the thalamus. In certain cases of epilepsy spikes were present in the thalamus but were not propagated to the cortex, and in other cases the discharge of the thalamus preceded that observed in the cortex.

Book Reviews

Le Psiconevrosi. By Lucio Bini and Tullio Bazzi. Price, 1,800 lira. Pp. 287, with 20 illustrations. G. Abruzzini (Top. P. U. G.), Rome, 1949.

This work, written by one of the developers of therapeutic electric shock and his associate, has just been published in Rome. It was given me by Bini for the purpose of translation during a recent visit to that city.

Both Bini and Cerletti are primarily neuropathologists. Bini's last previous book, published in 1948, was concerned with the presenile dementias and is largely a neuropathologic study of typical cases. A work on the psychoneuroses from the pen of a neuropathologist should therefore be most interesting. No new theories are presented, but valuable and constructive philosophic "slants" on etiology and therapy are presented. Original groupings and concepts are given.

The book is divided into four parts: (1) synthesis of the etiopathogenic and nosologic approaches; (2) analysis and critique of these approaches; (3) clinical descriptions; (4) diagnosis and therapy. The historical and contemporary coverage of the field is complete. In their "nosologic" approach, the authors include, besides neuroses and psychoneuroses, psychogenic reactions and psychopathic personalities. In their "etiopathogenic" approaches are included, besides the various psychoanalytic theories (Freud, Jung and others), expositions of the constitutional, genealogic (hereditary) and physiopathologic aspects; cerebral localization; experimental neuroses and hypothalamic-prefrontal theories and concepts.

In their critique of nosology, the authors reclassify the psychoneuroses, as follows:

1. The dysphoric group. This includes chiefly (*a*) the depressive mood changes in reaction to external events, short of manic-depressive psychosis, and (*b*) the anxieties. (Their description of the anxieties, anxious states, anguishes, etc., is a brilliant survey and synthesis of the entire field in all the various language groups of contributors.)

2. The "alarm," or neurasthenic, group. The Italian word *allarme* (literal translation, "alarm") comprises a far greater latitude of derived meanings than does the English "alarm." It does not bespeak a clinical entity but, rather, indicates a large group of pathogenic conditions corresponding roughly to a widely comprehensive use of "neurasthenia." Thus, the authors define it as consisting of a prevailing unpleasant feeling of fear and loss of confidence, signifying specific doubt in one's own capacity and one's own health, frequently justified by abnormal sensations referred to soma or psyche (the "psychesthesia of alarm").

The authors call attention to much overlapping with the concept of anxiety neurosis, admit the existence of anxiety in neurasthenia but point out that in neurasthenia it is a much less conscious anxiety but a feeling, rather, of discomfort and dubiousness concerning one's general health and efficient functioning because of the symptoms experienced. This is in disagreement with Freud, who contends that this symptom–complex is nothing more than a derivative of deeper anxiety.

A comprehensive historical survey of neurasthenia, from Beard's "nervous exhaustion," of 1869, to Schneider's present day "psychopathic personality of neurasthenic type," is given.

3. The obsessive group. This includes the compulsive and the phobic states. The distinctions between them are nicely drawn. Mention is made of the compulsive-obsessive phenomenon following encephalitis, the so-called thought, or ideational, spasms.

4. The hysterical group. This includes a wide variety of clinical syndromes, variously labeled in the different language groups of the authors. While hysteria has long been described as a disease entity, albeit with wide variations from one author to another, the later German school, which the Italian school seems to follow, speaks of "psychogenic reactions of an hysterical order" and "epithymic reactions," analogous to either defense or panic reactions seen in experimental animals. Relation to simulation and malingering is discussed. The authors point out that if the true hysterical symptom has a purpose, it is not to influence the environment to the patient's advantage but, rather, to express fear of being sick and disabled.

The third, or clinical, section follows the same grouping—namely, dysphoric or anxious; alarm, or neurasthenic; obsessive, compulsive and phobic; and hysterical. This section is a descriptive elaboration of etiology, symptomatology, course and treatment, illustrated by well chosen case reports. No brief is held for any particular theory or approach, but one gets the "psychobiologic" feeling in studying this exposition. Electric shock comes into the therapeutic picture, as one would expect, but it is discussed more fundamentally in the next section.

The fourth section is concerned with diagnosis and therapy. In diagnosis, differentiation is made, largely on a symptomatic basis, of the various aforementioned groups and also of these and organic conditions which may be simulated. The part on therapy is a critical review, by brilliant neuropathologists, of all the existing forms of therapy as related to the psychoneuroses—the psychotherapies and the somatotherapies. All psychotherapies, from the earliest method of suggestion to the latest "existentialistic analysis" (logotherapy of Frankl), are discussed. The same comprehensiveness applies to the chapter on somatotherapies. But of particular interest and value is the exposition of the convulsive therapies, especially electric shock, in relation to the psychoneuroses. The authors' sober and critical appraisal of results in their own experience, as well as those recorded in the literature, gives emphasis to contraindications as well as to indications. The former appear to outweigh the latter. The authors have devised an interesting scale evaluating convulsive therapy versus psychotherapy in the various groups of psychoneuroses. At the lower end are the conditions involving a greater participation of the vegetative nervous system: the psychosomatic reactions, the dysphorias, the anxieties and some of the neurasthenias; it is in these that electric shock is of some value. On the ascending scale, and with a diminishing neurovegetative participation, are more of the neurasthenias, the compulsions and obsessions, and the hysterias; here electric shock is largely contraindicated, and psychotherapy is the method of choice.

An appendix gives a critical and historical review of our knowledge of posttraumatic and "indemnity" psychoneuroses.

Approximately 300 references are given.

ARTHUR R. TIMME.

Morgagni's Syndrome. By Folke Henschen. Price, 30s. Pp. 172. Oliver & Boyd, Ltd., Tweeddale Court, 14 High St., Edinburgh, 1949.

The symptom complex of hyperostosis frontalis interna, virilism and obesity is referred to by Henschen as Morgagni's syndrome. The term syndrome is significant, since the author does not claim that the constellation of symptoms

constitutes a disease *sui generis*. The review is complete and thorough. The author approaches the problem through a study of the pathology of the disorder, based on a survey of 1,000 female skulls examined post mortem, with a control examination of the same number of male skulls. He emphasizes the fact that Morgagni's syndrome is a symptom complex occurring very often in women after the menopause, but developing less frequently in younger women. In the necrospy material studied, hyperostosis frontalis interna was observed in about 40 per cent of women after the menopause. Henschen states that the triad of hyperostosis frontalis interna, virilism and obesity belongs to the group of syndromes of the pituitary gland. He says, further, that "Morgagni's syndrome is on the whole only slightly pathological, and, in fact, need not be accompanied by any clinical symptom at all."

This study is one of the few serious attempts to determine by pathologic correlation the clinical significance of the symptoms in question. Henschen's conclusion that the syndrome is often without significance and unaccompanied with clinical symptoms is well supported by clinical observation. Though many symptoms appear to accompany the syndrome, their specific relation to the frontal hyperostosis and to the endocrine disturbances is not clear. Indeed, it may be said that the clinical significance of the syndrome itself remains in doubt.

The monograph constitutes a complete and careful study of Morgagni's syndrome. It contains a compilation of all the verified cases and a great deal of useful material of other sorts. It can be recommended to anyone concerned with an understanding of the problem.

The Question of Lay Analysis: An Introduction to Psychoanalysis. By Sigmund Freud, translated by Nancy Procter-Gregg, with foreword by Ernest Jones. Price, $2.50. Pp. 125. W. W. Norton & Company, Inc., 101 Fifth Ave., New York 3, 1950.

Surely it has long since become superfluous to introduce the author of this work, although it has been related, perhaps apocryphally, how a recent candidate for approval at the Board examination in psychiatry was overheard to ask another of his confreres, after his Gethsemane with an examiner or two, "Who is this guy Frude?" (rhymes with "rude"). On the other hand, we have learned painfully, to be sure, that it is quite to the point to know something about the translations of Freud. He who has lived with another language than his native own soon becomes aware on what a short tether one grazes with translations. Faust is perhaps as good an example as any with which to bring tears to mind, as was Don Quixote until recently. There is a story that makes the rounds periodically that Freud said of one of his translators, "Der Dummkopf versteht mich nicht." In the present case both author and translator have constructed an excellent book.

In this book, stimulated by legal harassment endured by one of his most able and literate nonmedical pupils, Freud put forward a powerful advocacy of lay analysis, which, interestingly enough, is not the topic that attracts us to it today. The book much more importantly comprises an introduction to the basic discoveries of psychoanalysis and their uses in therapeusis. The text is cast in dialog form; and, as Nancy Procter-Gregg, the translator, has noted, when a true Socratic spirit of inquiry is possible, the argument ranges wide and deep. Naturally, this logical and brilliant mind could not advocate procedure such as lay analysis without an examination of the fundamentals. Freud's graceful statement of the latter gives the inquiry its enduring value. He begins by describing a neurotic symptom, then discusses the nature of unconscious mental life and then the theory of the psychic structure of the personality as it is revealed in psychoanalysis.

It is worth reiterating that the sympathetic translation leaves nothing to be desired. This book is that most suited as an introduction to the study of psychoanalysis and is the answer to the question often asked by the novice, "What shall I read of Freud?"

Einführung in die Neurolgie. Bau und Leistung des Nervensystems unter normalen und pathologischen Bedingungen. By Oskar Gagel. Pp. 391. Springer-Verlag, OHG, Mölkerbastei 5, Vienna I, 1949.

This book is a discussion and interpretation of the symptoms of disorders of the nervous system in the light of its normal structure and function.

It begins with brief mention of the nerve endings, both motor and sensory, and continues with the peripheral somatic nerves, their roots and plexuses, and the sympathetic and parasympathetic systems. The author leans heavily on the extensive iconography collected by his master, Otfrid Foerster, in discussing the peripheral nerves. The discussion of the vegetative system is exceedingly brief.

In his discussion of the neuraxis, again, the author is at ease because of his long experience in Foerster's clinic, where he had at his disposal an abundance of pathologic material from all sorts of lesions of the spinal cord, both surgical and pathologic. This material has been used well in writing an excellent summary of the chapters which Foerster wrote for the "Handbuch der Neurologie." Gagel has done the student of neurology a service in digesting and making available to them the essence of those long, detailed and inaccessible treatises. The reader will find here a field in which the author has had an unexcelled pathologic experience.

Lesions of the brain stem have also been a subject of extensive study by the author, who has published, with Bodechtel, a beautiful atlas of the bulb and pons. Here, again, the reader has the benefit of the author's expert knowledge. The discussion of the cerebellum, on the other hand, will be disappointing to American readers. The illuminating American studies of this organ, many of them made during the war, are unknown to the author, whose discussion is correspondingly meager.

Professor Gagel gets under way with the hypothalamohypophysial system, which had largely been elucidated before the war, and he is in full stride again when he comes to the cerebral cortex. Here he also depends on the extensive documentation accumulated by Foerster. This material is summarized with great clarity and care. Although one who has observed the work of Foerster may question the accuracy of a great deal of the material, no one can doubt the brilliance of this synthesis. It is again very useful to have it here summarized and readily available.

The book ends with brief discussions of the meninges, ventricles, cerebrospinal fluid and methods of diagnosis.

In spite of its deficiencies, this book will be useful for the sections in which the author displays the mastery resulting from expert use of unexcelled opportunity. The book may be warmly recommended to all who are interested in the nervous system.

PERCIVAL BAILEY.

Mr. Carlyle, My Patient; A Psychosomatic Biography. By James L. Halliday. Price, $3.50. Pp. 227. Grune & Stratton, Inc., 381 4th Ave., New York 16, 1950.

This book is a psychosomatic biography of Thomas Carlyle (1795-1881), of whom it might be said, as it was of Herodicus ("Dialogues of Plato"), "He had a mortal disease which he perpetually tended, and as recovery was out of the question, he passed his entire life as a valetudinarian; he could do nothing but

attend upon himself, and was in constant torment, whenever he departed in anything from his usual regimen, and so dying hard, by the help of science, he struggled on to an old age, a rare reward of his skill."

From this book one derives the impression that Carlyle was indeed rarely free of discomfort—that his dyspepsia, chronic constipation, agitation, insomnia and other wretched feelings infrequently left him. Perhaps the picture is drawn as it should be in a psychosomatic biography written in the midtwentieth century, or perhaps this actually was the state of affairs with Carlyle. Even so, he lived a long and productive life and would have appeared on the face of it to have been rather completely successful.

Yet, as Halliday clearly depicts in this biography, the possession of a first class intellect is no indication of emotional maturity, and success is not equated with happiness. Even in his late years, Carlyle was not above traveling leagues to his mother's side for comfort, of whom he wrote shortly after her death (at the age of 83), "It was the earliest terror of my childhood that I might lose my mother and it had gone with me all my days."

Knowing just this much about Carlyle, with the use of modern insight, it would not be difficult to predict the fate of lovely Jane Welsh Carlyle (the subject of Leigh Hunt's "Jenny Kissed Me"), who married Carlyle when he was 31. After her death, in 1866, Carlyle wrote, "Oh, why do we delay so much, till death makes it impossible? . . . Oh think, if thou yet love anybody living wait not till death sweep the paltry little dust clouds and idle dissonances of the moment." Thoughts such as these recurred to him often, particularly in relation to his wife, and even as early as the courtship; but he was never able to be at peace in relationships that were more than formal and business-like. Mechanisms largely unconscious laid waste to forty years of married life, and, rather than the lovely partnership that might have been, it became something unlovely—a strenuous, dispirited, unhappy contest.

(See Jane Welsh Carlyle: A New Selection of Her Letters, arranged by Trudy Bliss. Price $3.00. Pp. 355, The Macmillan Company, 60 5th Ave., New York.)

Carlyle wrote that his father "was but half developed," as he reminisced how lack of education had left unfulfilled his intellectual potentialities. How truly the same words might now be applied to the son's emotional growth, for which the physicians of his day could give him little succor.

Halliday's biography relates how the modern physician trained in the elements of psychosomatic medicine would explain the case of that famous gastrointestinal tract, since Carlyle left a voluminous record of his feelings and notions. Matthew Arnold, the poet and essayist, considered Carlyle "part man of genius, part fanatic—part Tom-fool." Today we know better. We are certain that it is only in our time that the heart-felt prescription of Carlyle's semirejected friend, Jeffrey, given to him in relative youth, could have been followed, who felt intuitively that "You have no mission upon earth (whatever you may fancy) half so important as to be innocently happy."

Halliday's book is a delightful interlude for the physician interested in biography. Carlyle could not have known that he would have such a sympathetic biography, even though his bountiful record concerning his feelings surely reflects his striving to be understood.